Engineering News-Record

Devoted to Civil Engineering and Contracting

McGraw-Hill Company, Inc.

GENERAL LIBRARY
SEP 20 1920
UNIV. OF MICH.

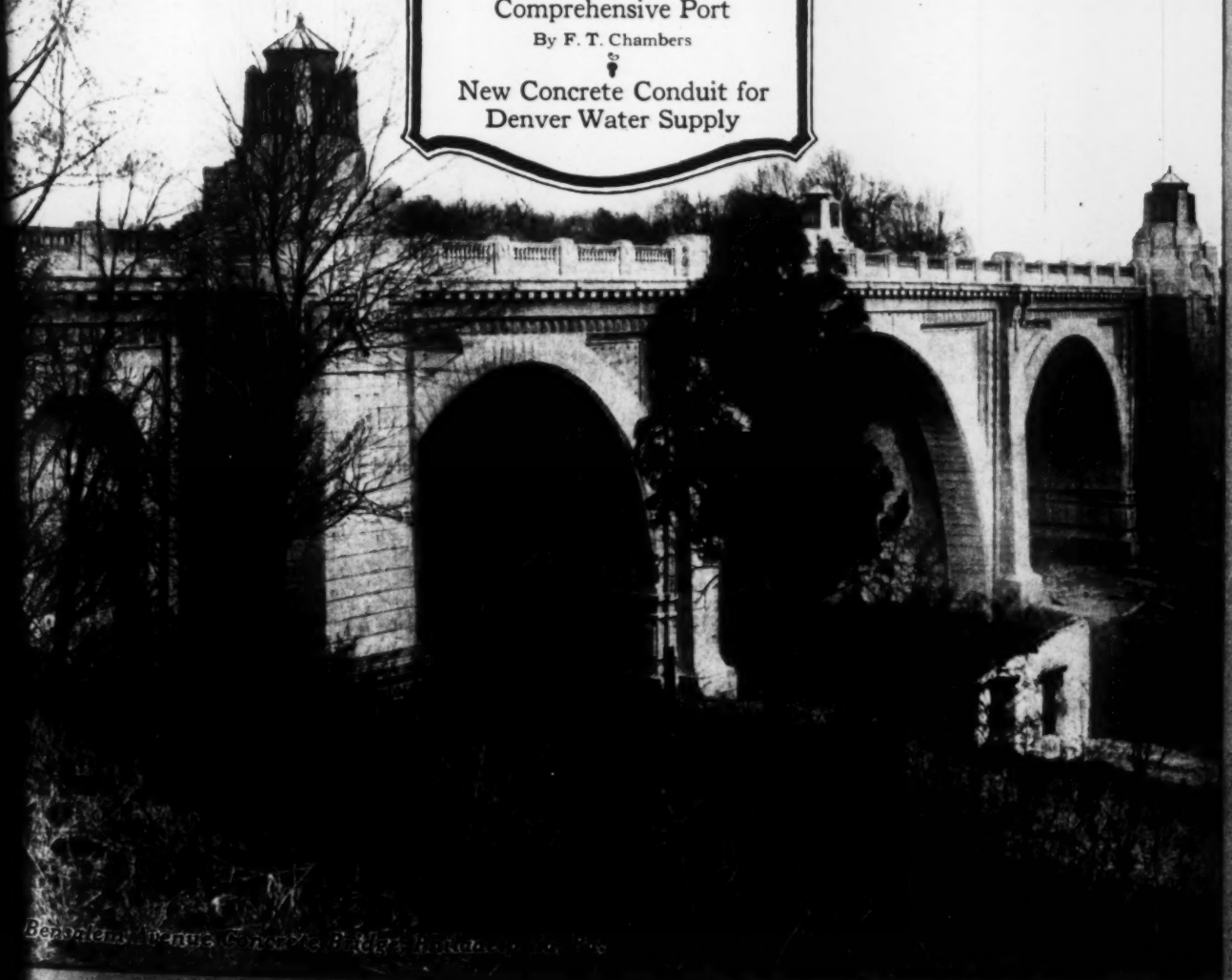
In This Issue:

September 16, 1920

Municipal Paving Far Behind State Highway Construction
By W. A. Bassett

Quays More Economical Than Piers for Comprehensive Port
By F. T. Chambers

New Concrete Conduit for Denver Water Supply



KREOLITE LUG WOOD BLOCKS

"The Paving that's Saving"

The World's Most Modern Street Pavement

Over a mile of Kreolite Lug Wood Blocks on Adams Street, Toledo, Ohio. This thoroughfare runs through the heart of the business district.

The Lugs on the blocks provide ample room for expansion, preventing buckling and retarding bleeding.

The Lugs also provide a spacing around each block which permits the Kreolite Filler to penetrate to the full depth of the block and when laid on Kreolite Pitch securely keys the pavement to the foundation.

Write for further information on Kreolite Lug Wood Blocks, "The Paving that's Saving."

THE JENNISON-WRIGHT CO.
79 Kreolite Bldg., Toledo, O.

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN
Editor

Volume 85 — NEW YORK, THURSDAY, SEPTEMBER 16, 1920 — Number 12

Plant Seizure in Italy

INDICATIVE of what may happen in Central Europe is the seizure by the workers of metal-working plants in Northern Italy. Without more intimate information one cannot predict the outcome. That the movement has not spread to all industries is encouraging, and indicates a non-soviet solution. The wisdom, or otherwise, of the government's non-interference cannot be gaged at this distance, though one is naturally inclined toward adverse criticism. Pessimism is not warranted at the minute, but the occurrence is an indication of the unstable conditions abroad.

What Is Art?

JUST as the engineer asks of the architect an acceptance of his assurances of strength in a structure, so must he accept the architect's assurance of beauty. Nevertheless strength is measurable and definite; beauty is neither, but too often lies only in the eye of the beholder. So the engineer may possibly be pardoned if he thinks that the Bensalem Avenue bridge, illustrated in this issue, is somewhat overdecorated. Unquestionably this structure is pleasing to look at and testifies in general to the wisdom of architectural assistance in bridge design, but to the engineering eye its embellishment is too profuse and its detail overemphasized. It is a fair question whether the engineer's instinct for simplicity in bridge design is not sound.

Getting Together on Pipe

AN ENCOURAGING feature of the convention of the New England Water Works Association at Holyoke last week was evidence that the Committee on Standard Specifications for Cast Iron Pipe and some, at least, of the pipe manufacturers are getting together. Two members of the committee recently visited a number of foundries and arrangements have been made under which pipe manufacturers will conduct some tests to throw light on questions at issue. Such co-operation is promising. Presumably the get-together spirit will also be shown by the similar committee of the American Water Works Association (the two committees are working jointly) and by still other makers of pipe.

City and County Consolidation

AMONG the causes of insufficient and uneconomical government in minor civil divisions is the maintenance of separate city and county governments where the area and population are largely the same. Engineers are more directly concerned with this inefficiency and extravagance in the duplication of engineering services. For some years past there has been a movement for consolidating city and county governments, but progress is slow. The subject, as applied to Seattle and King County, Washington, is vigorously discussed editorially in the Seattle *Times* of Aug. 4, following Mayor Caldwell's advocacy of consolidation. The *Times* urges that "every possible business economy is thrown to the winds when two separate and complete business administrations perform the same tasks in behalf of the nearly four-fifths of the county population which actually resides in the city." It goes so far as to assert that "the per capita tax of the 389,240 inhabitants of King County will be cut from 30 to 40 per cent, perhaps more, the first year we enjoy the consolidation." The subject deserves careful study by the engineers of Seattle and of other cities where like arguments can be advanced.

Belittling a Good Record

TYPHOID reduction in Massachusetts from 45 to 2.5 deaths per 100,000 in the past 35 years is something the State and the cities and towns of that commonwealth may well be proud of. It is all the more remarkable because it has been achieved with comparatively few water filtration plants and with only a little chlorination, as was pointed out by H. W. Clark in a paper before the New England Water Works Association last week. A member who, according to the secretary of the association, had not read Mr. Clark's paper, sent a written discussion (based on the title of the paper, "Innocence Better than Repentance") designed to show that the Massachusetts authorities have erred in not favoring filtration and chlorination and have thus put or left the people of the state in danger. Among other pleasantries, this critic said that the low typhoid in Massachusetts is due to the grace of God rather than to the State Board of Health. The old board may have been too conservative, but with such a record as it has made it should not be held up to ridicule.

Repaving in Municipalities

THE almost universal lack of an appreciation on the part of American municipalities of the necessity for providing adequate repaving programs is strikingly illustrated in an article by W. A. Bassett, appearing on p. 534. It may be because of the ever-changing character of city administrations, each one striving to establish a record of economy, that many worthy improvements are patched from year to year and passed on as liabilities to succeeding administrations. But it is a fact that real economies, that make for lasting municipal betterments, though large individual expenditures be necessary to insure them, are often overlooked. Proposed extensive construction and reconstruction projects recommended year after year by competent technical heads, are stricken from budgets with the cry that the taxpayer, who is also the voter, will find the financial burden involved unbearable. But in cutting out such improvements the politician both stamps himself as of unsound economic mind, and underestimates the real

intelligence of the taxpayer-voter. If it be economy to extend a net-work of improved highways into every producing center of this country, surely expenditures to keep in condition the streets in the zones of greatest traffic are justifiable. It is just as necessary that a municipality keep its streets in good order as it is for that same municipality to force public utilities, to whom it has granted franchises, to give the public the best of service. The engineer is not usually a wastrel and budget-making and approving bodies would do well to give a serious ear to his recommendations.

Hiding City Plans in the Safe

WHAT the world owes the inquisitive newspaper reporter is beyond estimate. At Bristol, Conn., his curiosity appears to have brought to light a report on city planning that represented some two years' work on the part of an eminent authority but which had been locked in the city safe for some time after the consultant's bill for $5,000 had been paid. The reporter's story of the case, but by indirection only, suggests three reasons why the plans were thus hidden away: (1) The estimated cost of the improvements recommended in the report was $2,000,000 and may have scared the authorities; (2) whether due to the city planner or the city officials or whether wholly unwarranted the idea may have got abroad that the chief aim of city planning is beautification; (3) there may have been too little educational work in connection with the city planning investigation. The last point perhaps deserves the most emphasis. Only a few people in even a fair-sized city have a clear conception of what city planning is. When someone in a given city becomes interested in the subject and succeeds in having a city planning commission appointed and an experienced city planner engaged to make a report, there is nothing done to tie the matter into the city government or to give either city officials or the public at large an understanding of what city planning is—a co-ordination of the many and diverse elements of the city plan and a selective program, extending over a term of years, for carrying out the elements of the plan in the order of their need and benefit to the whole community.

Highway Traffic Etiquette

LESS tangible problems than that which involves regulation of motor truck weights concern our several highway departments. Weight regulation is an out and out question of the exercise of the police power; but more difficult is that other problem—teaching the truck driver plain manners. All too noticeable is the fact that the heaviest cars usurp the highways. "Follow the middle of the road" may be sound moral advice, but it makes a poor traffic rule.

Commercial vehicles frequently surpass an 8-ft. width. On an improved road, whose metalled surface is but 18 ft. wide, such a car, traveling the road center, leaves a scant 4 ft. on either side. The ordinary truck driver, apparently adhering to the belief that might is right, having little fear from collision with lighter vehicles, usually pushes the passenger car to the last inch of road when passing. If that same passenger car is unlucky enough to pull up behind the truck, the chance the owner has of making the truck driver hear a horn above the rumble of engine and truck is doubtful. At street intersections and at crossroads the universal traffic regulation is repeatedly broken.

Educational campaigns carried on by highway commissions and by commercial motor-vehicle organizations for the benefit of their drivers cannot leave their impress upon some individuals. To these latter something more forceful than exhortation must be given. A man of public spirit is at least open minded; but the truck driver who exhibits contempt for anything under ten tons is deaf to ordinary argument.

Not at all passive has been the interest highway departments have exhibited in this disconcerting problem. One state, which has an extensive 1920 concrete program, took under consideration the advisability of constructing a ridge a few inches inside the road edges, the plan being to force the truck drivers, under penalty of arrest, to keep the right hand wheels outside the ridge. Added expense to sufficiently expensive construction, and cumbersome methods necessary for such installation, condemned the plan as impracticable. Nevertheless it is apparent that drastic measures to teach truck drivers the simplest traffic regulations are not an impossibility.

Education and exhortation have accomplished and will accomplish much, but if they cannot convince every driver concerned, physical or legal restrictions are the only alternatives.

What May Happen Will Happen

AN ENGINEER designs a bridge for any load that can possibly come on it, but should he find on his hands a weak bridge, if he be wise, he posts its safe loading. In other words, there is an equal obligation to design with an eye toward future operation and to operate with due regard for design as expressed in construction. If either obligation had been observed at Toledo the failure of the filter-basin baffle wall and roof, described on another page, would never have taken place.

This concrete baffle wall, 17 ft. high and 12 in. thick, was intendend merely to prolong the time of flow of water through the coagulating basin. As such its thinness, lack of reinforcement and horizontal construction joint were permissible and safe. But the layout of the basin was complicated by end transverse baffles which slowed up the flow so that there could be a head set up on the entry side of the longitudinal wall, and the wall, safe enough as a deflector, became decidedly unsafe as a dam. On top of this unstable dam was rested the free end of a flat-slab roof, so that failure of the wall meant failure of the roof.

The only defense of such a design is that it was intended that the flow through the basin should always be at such a rate as to restrict difference in head to a negligible amount. But a 16-ft. concrete wall, unreinforced, untied to roof or floor and only 12 in. thick, would be prohibited as an end support of a slab under any good building code. Because it happens to be inside a reservoir does not add enough to its structural integrity to make it good design. Being in such a reservoir it was not apt to be subjected to wind or one-sided earth load, but it was subject to a possible variation in head, not only from increased outflow but from stoppage of some sort between or around the baffles. Elementary structural design would indicate the advisability of spending a very little more money for columns or a sufficient wall.

Once such a structure was built, however, it was the duty of the operator to use it with due regard for its deficiencies. Possibly it is too much to expect that the operator would do other than accept the structure as safe for any designed conditions, though the weakness of the wall should have been apparent. If there was any head difference set up due to a change in operating standards, either the rate should have been lowered or the structure strengthened.

There have been so many basin-roof failures in the last few years that the real explanation of the Toledo failure was looked for with interest, particularly because this is the first flat-slab basin roof to drop. The report shows that the case is *sui generis* and that the type of roof had nothing whatever to do with it.

The lesson from the failure is rather for the sanitary engineer, who may take a leaf out of the book of the specialist in structures. He always assumes that what may happen will happen. Within obvious limits that is a pretty good maxim for all engineers.

Coming Activity in Railroad Bridge Impact Study

FOR two or three years past the bridge engineers of the Indian railways have been deeply interested in impact effects and impact allowances, with regard to both existing and new bridges. Some months ago this interest culminated in the dispatch of a representative to the United States for the purpose of studying at close range what had been done here. The situation presented by this incident has no less important bearing on American than on Far Eastern bridge development.

It appears that the belief has prevailed among Indian engineers for some time that the impact formulas developed in America, and for that matter the experiments on which they were based, are not directly applicable to Indian practice, in view of the different track gages of the railways there, the lower loads (and, in general, lower speeds), and manifold differences in bridge-construction practice. Whether justified or not, this belief had a gratifying result. it led to the decision to study impact thoroughly, on such a broadly planned basis, as to give prospects that results of greater value than those represented in American impact formulas will be obtained. Should this new activity on the other side of the globe result in reawakening interest among American engineers in the great number of unsettled questions in the impact field, the outcome will be doubly gratifying. We would then have reason to anticipate that the subject may be placed on a final basis of scientific knowledge. It is still far from reaching that stage.

Railway bridge engineers may fairly take pride in what they have accomplished hitherto toward mastering the perplexing intricacies of moving-load action. Their knowledge of impact effect under railroad trains contrasts strikingly with the almost complete lack of knowledge concerning similar effects in highway bridges, as was suggested in these columns last week. Several sets of remarkably painstaking experiments are on record, and formulas are in use that give satisfactory results in design. If the other side of the picture be looked at, however, we must recognize that even in the field of highway bridges our knowledge of impact is very far below the general level of the science of bridge construction.

That engineers in this country are for the moment somewhat apathetic toward the subject may well be thought surprising; yet it is a fact that their present inclination is to rest content with the formula incorporated in the new bridge specifications of the American Railway Engineering Association, and to assume that this disposes of the entire subject. But signs are already evident that the minds of some engineers, at least, are looking beyond this point, and there may soon come a decided resumption of activity in the field of impact.

With all due regard for the merits of simplicity in working formulas, like that in which all our impact tests have been summarized, true engineering cannot be content with these alone. It demands that in addition the fundamental data be brought together in a complete formula or set of laws, which will express broadly and accurately the influence of the various factors in the particular action concerned. So in impact—where our working formulas take note of no variable except loaded length—the engineer frequently needs to know what influence is exerted by other factors, as speed of train, or length of the path of stress (from load to stressed part) What knowledge have we of the effects produced by track irregularities and mechanical unbalance? Little or none. Improvement will of necessity be limited until such knowledge is obtained.

The unanswered questions have practical bearing in many directions. Thus, were it known what portion of the gross impact effect is due to vibration, it would be possible to estimate the gain to be obtained through more rigid construction, and the value residing in solidity of floor or roadbed construction—matters now dealt with in rather impressionistic fashion. Again, impact undoubtedly depends upon type and proportions of bridge, but aside from some uncertain conclusions on the effect of panel length we have no knowledge of these relations. It would be an advantage, further, if critical speeds could be predetermined without actual experiment. So there are many open questions, some of them bearing directly on design, others more on the estimation of the strength of old structures. The field remaining to be explored is a large one.

Auxiliary considerations that arise in connection with impact proper make the problem still more extensive. For example, whether flat wheels should be taken care of through impact allowances may be open to argument, but it is plain nevertheless that the action produced in such cases is analogous to impact action, frequently is combined with the latter, and pertains to the same field of knowledge, and it must be remembered that in the last analysis the railroad-bridge engineer has the duty of producing and maintaining a structure good not only for normal service, but, like any other piece of roadbed, for the abnormal conditions of derailment; under our present practice this contingency, too, is not provided for elsewhere than in the impact allowance.

Referring back to our present knowledge of impact action, the best that can be said is that an approximate range of the impact increment has been outlined by the many experiments already made. Great differences existing between individual observations within this range indicate sufficiently that factors of many kinds probably have influence on impact. Until these factors have all been identified, and their influence determined in at least an approximate way, the subject of impact cannot be considered to have reached a satisfactory stage or one in which bridge design is truly efficient.

Repaving—A Vital Problem for Municipalities

Opinion Held That Almost All Cities Have Failed To Keep Pace With Needs — Specific Examples Show Needs Are Four Times Annual Mileage Laid

By W. A. Bassett
Chief of Engineering Division, Bureau of Municipal Research, New York City

THE undertaking of a program of road improvement by the states and counties of this country involving the expenditure of more than $630,000,000, which was contemplated for 1920, is, in a sense, a climax to the program of educational propaganda for "good roads" which has been carried on consistently throughout the United States during the past 25 years. It is true that, on account of the prevailing high costs of construction, there has been a disposition in some cases to restrict the proposed construction program. However, the significance of the action of the public lies in the fact that it shows a wide and growing appreciation of the economic value to the individual citizen of improved smooth highways.

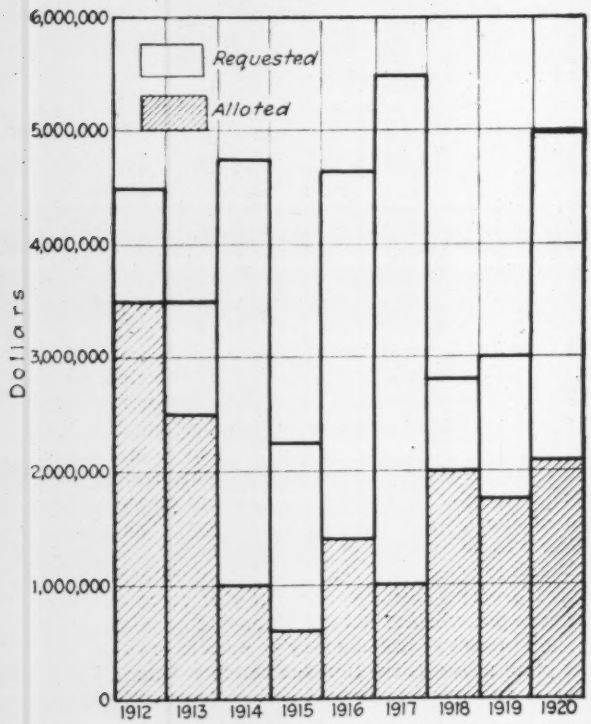


FIG. 1. RATIO BETWEEN FUNDS REQUESTED BY AND ALLOTTED TO MANHATTAN BOROUGH, 1912—1920 INCLUSIVE

While there has been during the past two decades commendable activity in the improvement of highways outside of the limits of cities, the latter units of government, almost without exception, have failed in their street improvement work to keep pace with the need for these facilities. This applies particularly to the matter of repaving, or the replacement of existing pavements, by those of an equal or more permanent character.

In all cities the need for new street improvements will be determined largely by the growth of the community or material change in the character and distribution of its traffic. Any increase in the mileage of paved streets not only places responsibility on the community for the suitable maintenance of those streets but also that of making provision for their replacement when worn out. In cities which are growing rapidly the problem of providing new pavements may be of greater importance than that of repaving. In the larger cities, however, the problem of repaving far exceeds in magnitude and importance that of new construction. In fact the Borough of Manhattan, New York City, so located as not to permit of physical expansion, and with its streets practically all paved, is an example of a community where the street improvement problem is one of repaving alone.

Pavement Replacement Policy

Any sound repaving policy should provide for the replacement of pavements within their economical lives. The end of the economical life of a pavement is reached when the capitalized annual cost of keeping it in a suitable state of repair approaches the capital expenditure required to replace it. In other words, the ratio between the cost of repairs and the cost of replacement affords a means of determining when repaving should be undertaken. Experience and judgment are required in the interpretation of this ratio as frequently many elements may affect any given case.

Thus the effect of a thorough repair of any pavement, even when it would appear that it had reached the limit of its economical life, may be to extend its period of usefulness several years longer. Also the greater desirability of a new pavement for the accommodation of traffic, or the character and location of the thoroughfare, may outweigh purely financial consideration in justifying a repaving improvement.

Furthermore, sometimes a community is confronted with the economic desirability of resurfacing streets originally paved with stone blocks, bricks or other pavements of a relatively permanent character which have become seriously worn. In such cases it may be found that the actual cost of keeping these pavements in a state of repair that will prevent hazard to the public, when capitalized, would not be sufficient to cover the cost of replacing these pavements entirely, although their condition might be such as to demand improvement. Conditions of this character are in many cases present in those pavements which were laid 25 years ago on sand or macadam foundations. Where these pavements are in large cities on important avenues of traffic their entire replacement by paving with suitable concrete foundations may be entirely justified, even admitting the extra cost. In small communities, however, the element of cost may be a serious factor, and in such cases experience has demonstrated the usefulness of surfacing these streets with some sort of an asphalt wearing surface without attempting to correct

fundamental defects in the pavement section. While obviously a wearing surface of this kind may have a relatively short life, yet the benefits that result from providing a smooth pavement frequently will justify such a temporizing policy. It is of course important that such pavements should be consistently maintained. This merely illustrates the fact that any repaving policy should not demand in all cases a complete replacement of the wornout pavement by a new one of the same or more durable character.

It should be pointed out, however, that the justification of such a policy would depend upon the extent and character of traffic using the streets in question; the relative permanency of the present surface, even if rough; and the probable cost of maintaining the new surface. Each case of this kind must be decided on its merits. It is important, however, to emphasize that any determination of required repaving depends upon complete and reliable data on extent, character and cost of maintenance and repair work done during the life of the pavement in question.

No Uniformity in Pavement Life

It is evident that there can be no uniformity in the average economical life of pavements. The experience of Buffalo, N. Y., according to the report of the city engineer for the year 1918 shows a high average of 23 years' useful life for asphalt pavements. The city of Washington, D. C., with strikingly dissimilar conditions, reports the even greater economical life of more than 25 years for the same type of pavement, while the average useful life of all classes of pavements in the Borough of Manhattan has been estimated in the 1916 report of the borough president as not exceeding 15 years.

Whatever the value of that element is, it, together with the extent and age of paved mileage of the city, gives a basis for determining what provision should be made annually for replacing wornout pavement. For example, in the case of the Borough of Manhattan with more than 450 mi. of paved streets, on the basis of an average useful life of 15 years, it would be necessary to replace not less than 30 mi. of pavement each year in order to keep pace with community needs.

That there has been little if any appreciation of these elementary principles, or at least practically no recognition of them by city administrations, is reflected in the almost universal lack of any consistent repaving policy and the inadequacy of funds provided for these purposes. The extent of the need for repaving may be illustrated by conditions prevailing in two large cities, Newark, N. J., and the Borough of Manhattan, New York City.

The repaving problem of Newark, N. J., is of particular interest as Newark may be justly termed a well-paved city both in the character and distribution of its paved streets. The mileage of paved streets in Newark during the period 1905 to 1918 increased from approximately 158.3 to somewhat over 271.4. Approximately 23 mi. of telford or macadam construction are included in this mileage. The relation between the total mileage of paved streets and the amount of new construction and repaving carried out during the above period is shown in the accompanying chart. An analysis of these data shows that on the basis of an average useful life of 15 years for pavements in Newark, assuming that conditions affecting pavements in that city are comparable with those in Manhattan, the demonstrable need for repaving during those years exceeds by about four times the amount actually laid.

The entire paving problem of Newark was studied by the writer during 1919 in connection with an administrative study of the city government made by the New York Bureau of Municipal Research. Data collected during the study were analyzed and in conference with the engineer responsible for directing street work the attempt was made to measure the actual street improvement needs of that community and to set up a work program for the years 1920-1924 inclusive. The conclusions arrived at were that it view of the insufficiency of the repaving program in the past the situation demanded the repaving of not less than 20 mi. of streets annually. If such a program were carried out the mileage of repaving required for subsequent years would be at somewhat less variance with the annual increase in new mileage. It should be noted that the above estimate was not based on complete replacement of pavements in all cases, but in its preparation it was assumed that where justified resort would be had to expedients of a relatively temporary character in order that a greater mileage of smooth wearing surface would be provided.

Perhaps the most striking example of complete lack of consistent policy in the matter of repaving, and the influence that political expediency has had in controlling expenditures for this important work, is that of the Borough of Manhattan. This is well illustrated by a consideration of the accompanying chart in which are plotted the requests for funds for repaving purposes made by the engineer through the borough president to the Board of Estimate and Apportionment, and the allotments made by that body for the years 1912-1920 inclusive. These years are selected because they are the only ones for which reliable data are available.

Repairing in Manhattan

While it is admitted that requests for budgetary and other funds made by city officials are sometimes predicated rather on getting "all the traffic will bear" than upon actual need, it is believed that the request made for repaving during 1912 represented a reasonable measure of the actual needs at that time. If all the requirements in this matter had been met up to 1912 the repaving need for that and subsequent years would be represented by a straight line. Admitting that such is not the case, if any consistent repaving policy had been adopted at that time the curve of requirements could be plotted as parabolic in character, rising until past needs for repaving had been met and then flattening to parallelism with the X-axis when the repaving program keeps pace with the needs of the community.

The chart shows a complete disregard of the fundamental principles that should govern a repaving policy and program. In fact the absolute failure to meet the obvious requirements for repaving work on the part of the Board of Estimate and Apportionment is a striking commentary on the lack of appreciation of that body of the important influence that smooth pavements bear on the economic welfare of the community at large.

The serious need of adequate funds for repaving in the Borough of Manhattan was forcefully presented in the report of the president of that borough for the year ending Dec. 31, 1916. This report states that:

The denial of appropriations which we have asked for repaving not only has prevented us from laying about 100 mi. of new pavements which the need of Manhattan demands but also has forced us to overtax our repair gangs and has resulted in an annual expense for repairs on such streets far in excess of the proportionate annual costs for the new pavements. This spells inexcusable waste. It is unfair to the taxpayers and also to our borough government, whose administrative expense is increased against its best business judgment. The average useful life of pavements in Manhattan is 15 years. Therefore, in order to keep our 456 mi. of pavement in proper condition and to prevent the necessity of repairing old pavements beyond the point of economy we should, under normal conditions, annually lay

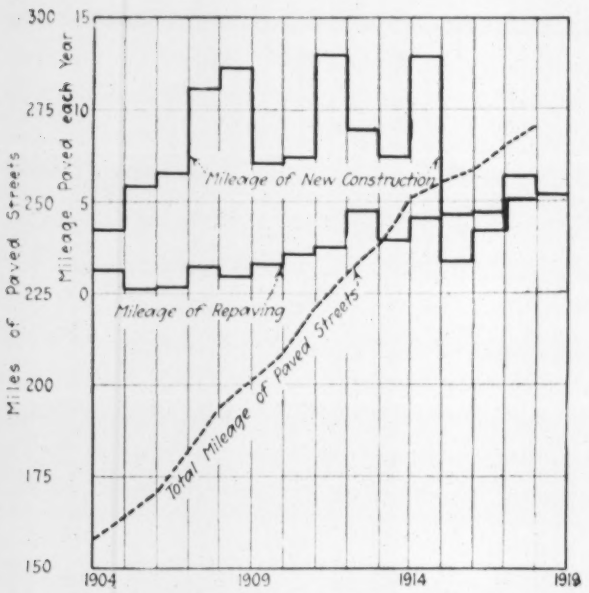


FIG. 2. ANNUAL PAVING AND REPAVING DONE, AND TOTAL MILEAGE, NEWARK, N. J., 1904–1918 INCLUSIVE

about 30 mi. of new pavement. In order to continue our policy of laying annually the normal amount of about 30 mi. of new pavement and also to replace the 100 mi. of pavement that has for several years needed replacing we should lay annually for a period of ten years about 40 mi. of pavement. This would entail an annual cost of about $4,000,000. At the close of this period the abnormal conditions would be overcome and the annual repaving appropriation would then be reduced to the normal amount of about $3,000,000.

Inasmuch as the money made available for repaving since 1916 has been materially less than that required to meet the normal need, the situation is today far more serious than at that time.

Repaving Necessity General

The examples of Newark and Manhattan are cited as illustrating conditions in two important large communities. The same serious problem either in greater or less degree faces practically every other city in the United States. Failure to recognize the value of keeping the streets of a city suitably paved is one of the most serious elements of economic waste that confronts society in those communities. It is reflected in congestion of traffic and delays in handling foodstuffs, frequent results of which are loss of perishable foods, increased cost in operation of motor and other vehicles as reflected by both high repair costs and shorter useful life of vehicles, and a loss of time in transacting business, which, in the last analysis means financial loss. If these various elements of loss could be capitalized, it would be seen that expenditure of sums far in excess of those expended today would be justified to prevent them. That there is nothing academic about this claim has been demonstrated by the results of a series of tests conducted during 1918 by the Portland Cement Association to determine the amount of gasoline required to operate motor trucks over different types and conditions of roads. This information, a résumé of which was published in the *Engineering News-Record*, Nov. 7, 1918, p. 843, shows variations in the cost of operation due to this element alone ranging from 16 to 90 per cent above that required for operation over a smooth road surface. Moreover the comparison made is between a smooth brick or concrete pavement taken as standard and other types of road in fair to good condition. If the owners of automobiles and other motor vehicles who use the streets of a city could be made to realize that poorly paved streets may double the amount of gasoline required to operate their machines within the city, it is reasonable to believe that there would be little or no opposition from them to a sound repaving policy and program.

The effect of road improvement in economy of transportation has been demonstrated conclusively throughout this country. Perhaps one of the most striking experiences of this character is that of Los Angeles County, California, described in the *Engineering News-Record*, July 31, 1919, p. 214. A comparison of accurate traffic censuses with haulage contract prices over both improved and unimproved roads in that county indicates that, on the basis of saving in haulage per ton-mile up to the time that report was made, three of the main roads out of Los Angeles had paid for their original cost and maintenance about nine times during the preceding four years. There does not appear to have been recognition of the possibilities of analagous saving over city streets subject to intensive traffic. At this time when there is the greatest need for conservation combined with maximum production, it is particularly imperative that those who are responsible should recognize the extreme importance of a sound repaving policy.

Caribou Hydro-Electric Project

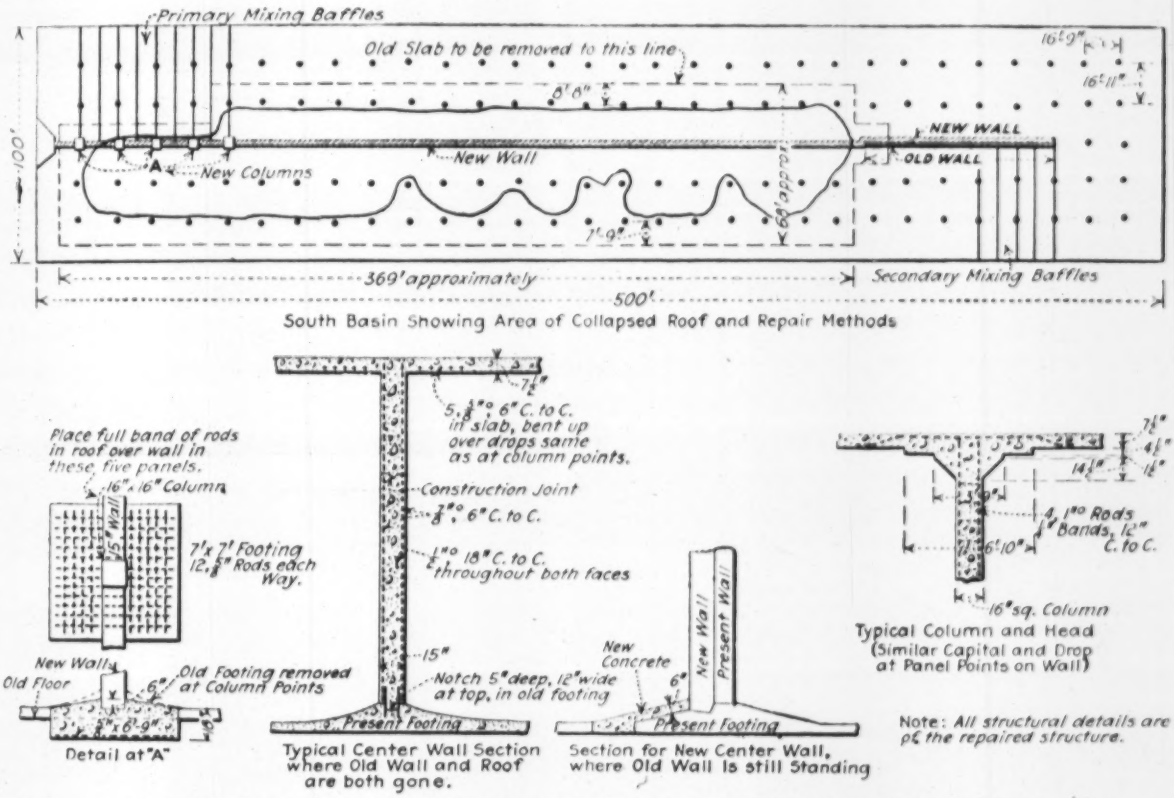
The hydro-electric development known as the Caribou Project which the Great Western Power Co. is constructing on the Feather River in California has reached such a stage that completion early next year is now believed to be assured. Construction of the 165,000-volt transmission line for a distance of 185 miles from Caribou Power House to Valona substation is well under way. Most of the towers are up and the aluminum conductor cable, which is approximately 1 in. in diameter has been delivered. The line is to be completed this fall some time before other parts of the project can be finished. The Caribou Plant, which is next to the uppermost in a proposed chain of seven plants to utilize successive drops in the 75-mile stretch of the Feather River between Lake Almanor and Oroville, will have an ultimate capacity of 120,000 kw. in six 20,000 kw. units. Two 20,000 kw. units are to be installed now. The water wheels will be of the impulse type operating under a head of 1,008 ft.

Collapse of Basin Wall and Roof at Toledo

Filling Sedimentation Basin Too Rapidly Builds High Head Against Thin Baffle—Roof Pulled Down by Wall

FOLLOWING the too rapid filling of a sedimentation basin at the Toledo, Ohio, water filtration plant a 350-ft. length of concrete baffle wall, 12 in. thick, collapsed Aug. 1, at 11 a.m. carrying with it 54 panels of concrete roof slab and 16 columns. The baffle wall extended nearly the whole length of the basin (Fig. 1) and so that it finally rested just beyond the bottom portion. The wall was keyed into both the roof and the floor of the basin, but had no reinforcement connection with either.

The difference in water elevation on the two sides of the longitudinal baffle wall before the failure was computed by noting the difference in water depth (9½ ft.) in the basin after the wall was down and the depth on the high side (11 ft. 10 in.) as indicated by the water mark and taking into account the relative areas (see Fig. 1). This computation showed the difference or head of 5½ ft. already mentioned. The difference at the inlet-outlet end, or at the primary mixing chamber


Primary Mixing Baffles
Old Slab to be removed to this line
16'-9"
16'-11"
8'-8"
NEW WALL
OLD WALL
New Wall
New Columns
100'
7'-9"
369' approximately
Secondary Mixing Baffles
500'
South Basin Showing Area of Collapsed Roof and Repair Methods
Place full band of rods in roof over wall in these five panels.
16" x 16" Column
7'x 7' Footing 12-⅝" Rods each Way.
New Wall
Old Floor
Old Footing removed at Column Points
6"
8'-6"x 6'-9"
Detail at "A"
7½"
5-⅞" ø 6" C. to C. in slab, bent up over drops same as at column points.
Construction Joint
⅞" ø 6" C. to C.
1" ø 18" C. to C. throughout both faces
15"
Notch 5" deep, 12" wide at top, in old footing
Present Footing
Typical Center Wall Section where Old Wall and Roof are both gone.
New Concrete
6"
New Wall
Present Wall
Present Footing
Section for New Center Wall, where Old Wall is still Standing
7½"
4½"
12"
14½"
4-1" ø Rods
⅜" Bands, 12" C. to C.
6'-10"
16" sq. Column
Typical Column and Head (Similar Capital and Drop at Panel Points on Wall)
Note: All structural details are of the repaired structure.

FIGS. 1 AND 2. SOUTH BASIN SHOWING AREA OF COLLAPSED ROOF AND REPAIR METHODS

not only served as a baffle but was also utilized in carrying the roof instead of a line of columns. It divided the basin into an inlet and outlet side which contained primary and secondary mixing chambers at opposite ends of the basin and on opposite sides of the longitudinal baffle wall, as shown in detail by Fig 3. The loss of head caused by the secondary mixing chamber baffles created a difference in water level on the two sides of the longitudinal baffle wall, which increased with volume and velocity of the water passing through the basin. The nominal rate for which the baffles were designed were 22,000,000 gal. daily but 30,000,000 gal., the recent rate of operation, was considered safe. The rate of filling which caused the collapse of the wall by building up a head supposed to be 5½ ft. was 45,000,000 gal. The wall that failed was not reinforced and for much of its length had a construction joint at two-thirds its height. The wall apparently broke along this joint. The bottom part tipped over and was pushed into the outlet side of the basin as much as 10 ft. The top portion was carried with the outrushing water was of course greater by the loss of head in the primary mixing chamber.

No one saw the collapse, but two operators had just come from the reservoir top and they report nothing unusual. Approximately the same high rate of filling had been used for eight months during alterations and additions to the filters. There seems no doubt however but that the part of the longitudinal wall along the primary mixing chamber collapsed first, because one section of the stilling wall just beyond the passes fell backward toward the passes indicating a sudden release of water from the mixer section. The openings in the walls of the mixer system consist of 2½ x 2½-ft. slide gates cutting off the gutter and 2 x 2½ ft. swinging gates at the wall side. The latter was counterweighted to open under a 1-ft. head. Two of them were found to bind slightly on the concrete but could be operated by pushing with the foot. Another in the last baffle back of the collapsed portion of the stilling wall was out of its bearings and one bearing was bent around 90 deg. Originally there were "over" baffles between

How Baffle Wall Failure Damaged Toledo Basin

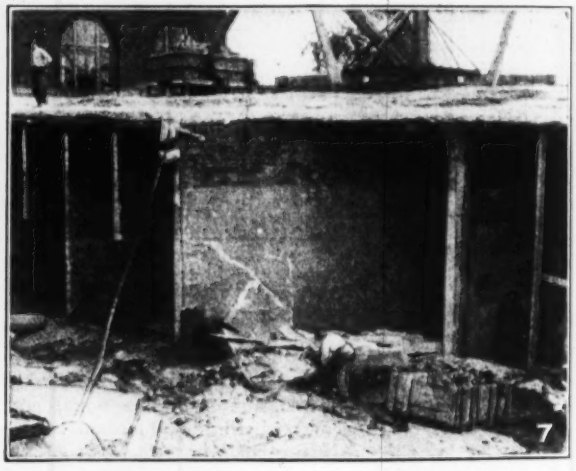
4. When Wall Fell Roof to South Dropped Like a Curtain. 5. North Wall Roof Collapsed Irregularly. 6. Stilling Wall Fell Backward Against Baffles. 7. After Removal of Débris—Under Passes at End of Passes—Swinging Gates in End of Over Passes. 8. Derricks Remove Débris—Men Cutting Roof Slab. 9. Shows Shearing Around Column Heads—Slots Cut to Remove Slab to One-half Panel Line. 10. Cutting up Concrete Wall.

5

6

4

9


7

10

8

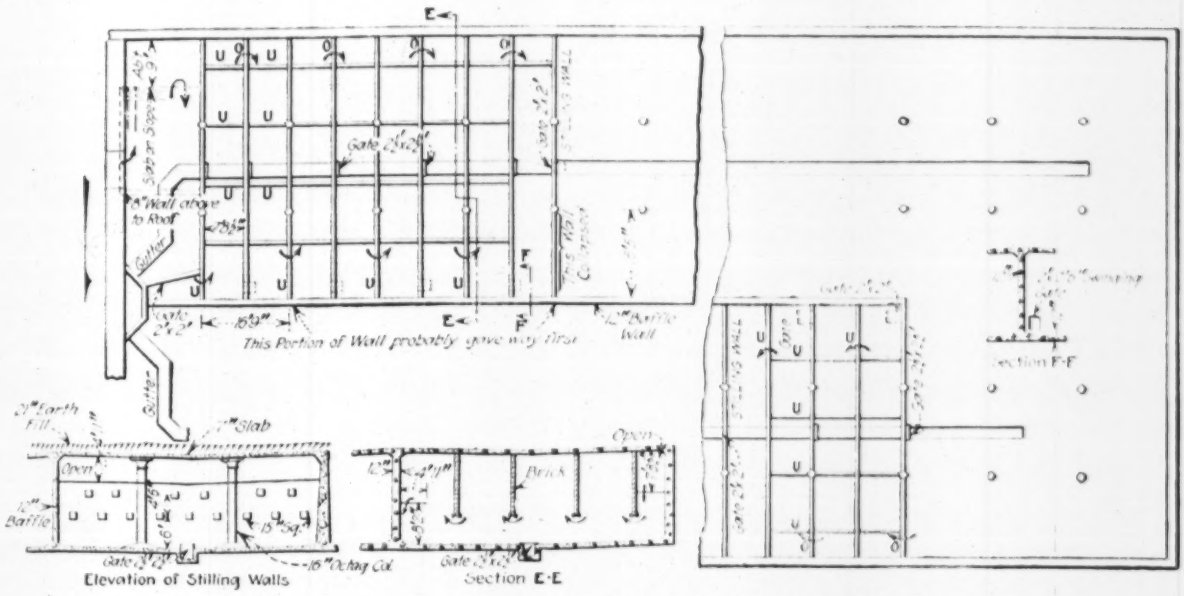


FIG. 3. PRIMARY AND SECONDARY SYSTEM OF MIXING BAFFLES AT TOLEDO FILTRATION PLANT

successive "under" baffles. Because of the excessive loss of head these "over" baffles were removed about three years ago.

The top of the slab is at El. 157.58 over the baffle wall and the floor of the basin at El. 140, so that with the 7-in. slab and 12 in. pyramidal base, the clear height of the wall is 16 ft.

The flat-slab, 7-in. roof supporting 20 in. of earth is one of the early C. A. P. Turner types with bands of eleven ¾-in. round rods spaced 8-in. on centers running longitudinally, transversely and in both diagonal directions. Over the wall the longitudinal band was omitted and no column-head bars were placed. The wall was used simply as a rest. When it fell it broke 16 columns thus letting down the panels back of the columns. The slab over the high (south) side parted on the construction joint midway of the panels and that portion nearest the columns dropped nearly intact and hung by the rods like a curtain. The photographs show this condition and the manner of the collapse on the other side where the columns were broken.

Repairs were undertaken immediately, two derricks with 60-ft. booms being used to hoist the débris out of the reservoir to the south side. The hanging curtain of slabs was released and the mass of tangled reinforcing was cut up by oxy-acetylene flame and bull nippers. The larger blocks of concrete were broken up by sledges and the roof cut back to the lines indicated on the drawing by sledges.

A new reinforced-concrete wall capable of withstanding the full pressure of the water will replace the old one, a 5-in. notch at the bottom being cut in the old base, in order to permit using each half of the basin independently if desired in the future.

Opposite the primary mixing chamber regular columns are to be placed at the panel points in the wall so that the wall between columns can be built separately and torn out should a new set of mixing baffles be desired.

For the five panel lengths of wall which did not fall the new wall is to be built alongside the old one using the latter as a form.

The roof panels are being replaced by a 7½-in. flat slab designed to meet the Pittsburgh building code requirements. Fifteen ¾-in. round bars spaced 6-in. on centers are to be placed in each band instead of eleven bars. The bands will be raised over the column heads which are to be square and dropped 4½ in. Considering the punishment the old slab has stood it was felt unnecessary to use the more rigid Chicago code requirements.

Rather than attempt to salvage the line of columns on the break they are being removed and the slab cut back to the one-half panel line. This was done to secure an advantageous construction joint. A crack or a construction joint already existed on this line. Details of the reconstruction are shown in Fig. 2.

W. G. Clark is consulting engineer on the repair work, which is under the general direction of D. H. Goodwillie, director of public service and superintendent of water.

The Best Type of Improved Highway

The Bureau of Public Roads frequently receives requests for information as to the best type of road. Some of the letters asking for this information come from persons not versed in the technicalities of road construtcion and the question is put with the evident assurance that return mail will bring a specific answer to the inquiry. Engineers ask the same question—not so blandly but when the letter is stripped of its technicalities it amounts to the same thing.

This is the way that Thomas H. MacDonald, the Chief of the Bureau, answers such inquiries:

The best type of road to build must be judged by adequate service to the road user. As local conditions differ, so will the best types of road. The best type of road is the one which at the least cost will give the best service. A road that will give adequate service is the first requisite. It is probable that a number of types of road will give that service. Consequently some one of those types must be selected. A proper selection is the one which best meets local conditions. It is an offense against the public to transport materials for long distances when adequate substitutes are available locally.

Progress Shown in Water-Supply Practice

Abstracts of Papers Read Before the Thirty-ninth Annual Convention of the New England Water Works Association, Holyoke, Mass., Sept. 7-10, 1920

Instructions to Employees at Pumping Stations and Filter Plants

By Dow R. Gwinn
President and Manager Water Co., Terre Haute, Ind.

IN OPERATING water plants the author has tried to find the best way of doing things, and then to adopt them as standard methods, even if they are difficult, and holding to them until better ways have been found. The instructions are typewritten and are kept in a loose leaf binder. Changes can be easily made and additional sheets may be readily added. No method is so sacred but what it can be changed by the manager. The employees are encouraged to suggest better methods and when tried and found to be advantageous they are substituted for old ones. Each employee is supposed to read the instructions once a month; he may select his own time while on duty for the reading. A sheet of properly ruled paper is enclosed in the file on which is the list of employees and each employee records the date when he reads the instructions.

The Terre Haute plant takes its supply from the Wabash River and is a direct pumping plant. For pumping into the distribution system there is a 10,000,000-gal. vertical triple expansion and a 6,000,000-gal. vertical compound; also, smaller pumps. For delivering to the sedimentation basin there is a centrifugal pump operated by a compound high-speed engine connected with a rope drive. Steam is generated in water tube and fire tube boilers with hand firing. A vacuum pump for exhausting air from the suctions of the principal pumps is a part of the equipment. There are 22 mechanical pressure filters. There is a sedimentation basin with sufficient capacity for approximately 2 to 5 hours subsidence. This is only used when the turbidity exceeds say 60 on the Jackson turbidimeter, or about 55 per cent of the time. The turbidity of the river water ranges from 25 to 3,000. The pumps work against 70 lb. domestic pressure and 125 lb. fire pressure. The available fire pressure at hydrants in the business or high hazard district is 100 to 110 lb. While the fire department is equipped with pumpers, they are seldom used—the pressure from the plant being usually sufficient. There are 100 miles of mains, 62 per cent being 8 in. and larger diameters. There are 1,155 public fire hydrants. There are 8,240 consumers; 97.7 per cent of all service pipes are metered, including private fire lines for automatic sprinklers.

At the plant a program clock is provided which summons the attendants every half hour to examine the water. This is just a visual examination of the raw and filtered water and a record of the appearance of the water is made. This is necessary because of sudden changes in the turbidity of the raw river water.

A record of fire alarms is kept, showing the length of time extra pressure is maintained, increase in pumping rate, time of receiving alarm and strike out; also hydrants used and condition after fire. Inspectors answer alarms received from high hazard districts during day and second alarms at night. Engineers and firemen are on duty 8 hours; that is, they are off duty 16 hours per day for six days and the seventh day they are off 24 hours. Monday is change day when each man moves up one watch, the duties during the eight hours being performed by other employees. The changes are made at 7 a.m., 3 p.m. and 11 p.m. Employees are given two weeks' vacation with pay. Baths are provided for the men, also books on engineering and technical publications. The grounds on which the station is located were laid out by a landscape gardener and are very beautiful. A fine tennis court is provided. Long periods of employment are the rule, one engineer having recently completed thirty years of continuous employment. The company arranges and provides for an annual picnic on the station grounds for employees and their families.

The instructions which follow have been found to be satisfactory for the Terre Haute plant and while they would not be suitable in every particular to any other water works plant, they may be suggestive and valuable to other operators. [Separate instructions, not here reprinted, cover all elements of the plant—Editor.]

The Management and Finances of the Holyoke Water-Works

By Patrick J. Lucey
Engineer Water-Works, Holyoke, Mass.

THE Holyoke Water Department is operated under a commission of three unpaid members appointed by the Board of Aldermen. The commissioners select the officers and employees of the department, levy the rates, and collect and disburse the funds of the department through their own treasury.

The Water Department is self-supporting; in only one instance was it ever granted an appropriation raised by general taxation and that was in the early days before the department finances were well established, when $10,000 was granted. In 1901 this loan with interest at 4 per cent for the whole of the period was returned to the city treasurer.

The present rates, which were established in 1909, provide for the sale of water by both the fixture and the meter measurement methods. The annual fixture rates are as follows:

For each family	$3.00
For each bath-tub	$2.00
For additional bath-tub	$1.33
For closet	$2.40
For additional closet	$1.60
For garden hose (limited use)	$2.40
For rotary hose	$9.60
For automobile	$1.60
For washing machine	$1.60

Metered water is charged at the flat rate of 5⅞c. per 1,000 gal., the bills being rendered monthly and 10 per cent discount allowed for prompt payment. A minimum yearly charge of $5 per apartment is established for all apartment houses on the metered service.

Meters are owned, installed and repaired by the Water Department and the annual rental for their use is from $2 per ⅝-in. and ¾-in. upward.

Assuming that the unaccounted for water was 30 per cent of the total quantity passed by the master meters in 1919, the cost to the consumer of water sold by meter measurement was 5¼c. per 1,000 gal.; by fixture rate, 11.8c.; and the average cost to all the consumers 8.3c. per 1,000 gal.

The total cost or book value of the Water Department at the close of the last fiscal year was $1,969,892. The bonded debt was $441,000 and the amount in the sinking fund to meet that portion of the debt financed on the sinking fund method was $193,207, making the net debt $247,793, or 12½ per cent of the total cost, and the net cost of the plant to the water takers $1,722,009.

The gross receipts from all sources for the year 1919 were $168,805, equal to 8.6 per cent of the total cost.

The largest item of department expense after salaries and wages is the one generally called "payment of taxes" to the City of Holyoke, this being so far as is known to the writer, the only water department where such payment is made under legislative enactment. The various municipal departments are required to pay for water used and for fire hydrants [$8 per public hydrant] the same as to a private water company.

The total of all payments made by the Water Department to the city treasurer under these provisions is $422,556, and the amount received by the Water Department from the other municipal departments is $215,863, making the net cash contribution made by the water takers for the benefit of the general taxpayer $206,693.

Office Methods and the Water Consumer

By Reeves J. Newsom
Commissioner of Water Supply, Lynn, Mass.

THE new consumer, when he applies for water in Lynn, is presented with a card form of contract which he is required to sign, and when he does so he has practically forfeited all his rights, as the contract contains these stipulations:

"In consideration of the supplying of said water, said owner hereby agrees to pay for the same in accordance with such rates as are from time to time established, and this agreement to pay shall remain in force and be binding upon him so long as the city of Lynn shall continue to supply water to the said premises, unless he shall have notified the said city in writing that he no longer desires the water service and shall have stated in said notice the name of the new consumer. He agrees to be bound by the rules and regulations of the Water Department and all subsequent changes therein and to pay all charges for excess piping or special construction as prescribed in those rules and regulations. It is understood and agreed that the city of Lynn does not guarantee to furnish constant pressure nor uninterrupted service."

[Regulations to cover various contingencies are given in the original paper, after which meter consumers are considered.—Editor.]

It was recognized by the writer that it is very essential for the department to have complete control of the meters, but with 5,500 services unmetered, and the hope that they will be metered in the near future it was desirable to contrive some means of keeping this control without having to furnish the capital for the installation of so many meters.

Control of Meters

The following paragraphs from the regulations show how the proposition is handled:

"All users of water through metered services shall pay the cost of a proper sized meter installation and thereafter the maintenance of same shall be by the Water Department, which shall include all ordinary repairs and replacements. All repairs of injuries to meters from freezing, hot water, or external causes shall be charged to the consumer. Charges for a new meter installation will, at the discretion of the Commissioner of Water Supply, if requested by the consumer, be levied in equal parts, due and payable with each of the first four quarterly water bills, and all such charges when paid shall be retained by the Water Department and credited to such meter installation and in the event of failure to make payment of such charges when due, the Water Department shall have the right to shut off the water under the same procedure as for other Water Department charges.

"The proper size of meter required for any given service shall be determined by the Water Department, which shall in all cases furnish the meter to be used, the same to be such type and make as said Water Department shall deem proper.

"All meters shall be set by an employee of the Water Department, and shall not be moved or disturbed except by the same.

"The department shall have the right to remove, repair, or replace any meter at any time it sees fit. All meter installations on services which cannot be shut off for meter repairs shall be equipped with a by-pass at the expense of the consumer.

"If, in the opinion of the Commissioner a meter does not fit the conditions of the service installation, the Department shall have the right to change such meter and charge or refund the difference in value of the meters exchanged."

No new accounts are opened except for metered water. The fifty-five hundred fixture accounts are hold-overs, and are gradually being done away with. The houses on fixture rates are inspected and billed twice yearly. The metered consumers receive bills quarterly, but as a matter of service all meters are read monthly, and any excessive flow of water is called to the consumer's attention that he may put a stop to it at the end of the first month.

It is interesting to note that it costs as much in a year to make 11,000 inspections in houses having fixtures as it does to make 90,000 meter readings.

Operation of a True Siphon on a Main Supply Pipe

By Wallace R. Braun and Charles W. Sherman,
Supt. of Water Works, Hallowell, Me. Consulting Engineer Boston, Mass.

TRUE siphons in water-works practice are of very rare occurrence—so rare that the writers have not been able to find any published record of the operation of such a siphon. It may, therefore, be interesting to water-works men to learn of the conditions encountered in operating such a siphon on a main gravity supply pipe.

A supply of water for Hallowell was originally obtained from the headwaters of Cascade Brook, about 1.5 miles northwest of the city. Two small reservoirs were constructed on the brook, and a 6-in. pipe laid from the lower reservoir to two distribution reservoirs just west of the built-up portion of the city.

The intake in the reservoir is approximately 8 ft. below spillway level. The pipe leads from the reservoir across a valley perhaps 40 ft. lower, and then rises, crossing a ridge at a distance of about 6,000 ft. from the reservoir. The elevation of the surface here is approximately 9 ft. above the high-water level in the reservoir, and the pipe is about 3 ft. above high water. From this point the pipe descends sharply to distribution reservoirs which are about 41 ft. lower than the supply reservoir.

The portion of the ridge lying above the elevation of high water in the reservoir is 500 or 600 ft. in length, measured along the pipe, and it would have been necessary to excavate at least this length of trench in rock to locate the pipe below the hydraulic grade line.

The method of operating the siphon was as follows: Valves at the inlet and discharge ends of the supply pipe were closed; the air valve at the summit was opened, and a supply of water from a small reservoir, 20 or 30 ft. higher in elevation, was drawn through a 2-in. pipe into the 6-in. pipe to charge the siphon. When all the accumulated air had been expelled at the summit, the air valve was closed and the supply cut off from the upper reservoir; the gates at the inlet and discharge ends of the pipe were opened, and the siphon would operate without attention until a sufficient quantity of air had accumulated at the summit to break the siphon. The efficiency of the siphon began to decrease almost immediately and gradually fell off until the flow practically ceased. It was the custom to manipulate the valves at 7 and 11 a.m. and 4 and 7 p.m., and under this scheme the siphon was operated with a fair degree of success.

It was suggested [by Metcalf & Eddy, consulting engineers, Boston,] that if some automatic means could be provided by which air could be removed from the summit as it accumulated there was no reason why the operation of the siphon should not be made continuous. An electric power line crossed the summit in close proximity to the pipe so that electric power was readily available, and there was no reason to doubt the practicability of providing an automatically controlled air pump for the removal of the air. No definite information as to the quantity of air to be handled could be obtained. From the fact that the siphon had been operated with a fair degree of success when operating the valves at intervals of 4 or 5 hours, it seemed obvious that the accumulation of air could not be very rapid. The matter was taken up with C. O. Rogers, engi-

neer for the Charles J. Jager Co., Boston, who suggested the following equipment for this installation:

1 Receiver 24 in. diameter by 36 in. in length, of reinforced-steel construction, with supporting cradles and 6 in. flanged yoke.
1 Water glass and fittings for indicating water level in the float chamber.
1 Copper deposit float with necessary connections for the operation of float switch.
1 Triple pole float switch of the enclosed type.
1 Gardner compressor unit, 3 x 3½ in., air cooled, with extended motor base and belt and idler drive. Capacity of compressor 8 cu.ft. of free air per minute.
1 1½-hp., 3-phase motor, 1,800 r.p.m. for 220-volt current.

After some consideration an order was placed with the Jager Co. for this apparatus.

A vault 12 ft. long, 6½ ft. wide and 8 ft. deep was built enclosing the pipe at the summit, where a T-branch was set, turned up. The air tank or receiver was mounted upon this T and a small wooden building previously located over the air valve, was placed over the entrance to the vault. Considerable rock excavation was involved in this construction. The total cost of the installation is estimated as $1,600.

The apparatus was put in operation on Dec. 15, 1918, and has been in practically continuous service ever since. The operation is entirely automatic and the siphon is maintained in continuous operation. It is, of course, necessary to throttle the valve at the discharge end of the supply pipe where it enters the distributing reservoir, in order to prevent breaking the siphon, due to the excessive drop in this leg of the siphon, and also to avoid depleting the reservoir too rapidly.

During the year 1919 the cost of electric power for operating the vacuum pump was $85, the price being 9c. per kw.-hr., and in addition the cost of electric lights for the vault was $9, making a total cost of electric current $94. If interest and depreciation on the investment be assumed at 7 per cent, or $112 per year, the total cost of operating the siphon during 1919 was $206.

When the apparatus was first installed, the pump operated only about once an hour. It was found, however, that at times when the water in the reservoir is comparatively low, much more air accumulated, and in July of this year the pump was found to be operating about once in five minutes. The difference in water level in the receiving tank, between the time of starting and stopping the pump is about 6 in., corresponding to an accumulation of air of approximately 3 cu. ft.

It is probable that when the water in the reservoir is low, more air enters the pipe at the inlet end in solution or in suspension in the water, and it is also possible that some air is drawn in by vortex action. The period of low water in the reservoir also corresponds to the time of low ground water, when a greater amount of the pipe which is below the hydraulic grade line, and therefore subject to negative pressure, is below ground water level. Under these circumstances more air would probably be drawn into the pipe, through joints, than when ground water is high.

The pump maintains a vacuum of approximately 21 or 22 in. of mercury, corresponding to about 24.5 ft. of water. The hydraulic grade line at the siphon is therefore about 24.5 ft. below the pipe at the summit of the siphon, and 20 or 21 ft. lower than the water in the reservoir.

Water-Works Service Pipes

By D. A. HEFFERNAN,
Superintendent Water-Works, Milton, Mass.

MANY inquiries are made to water departments relative to different conditions existing in the house service. Although in many cases the responsibility of the water-works ceases at the meter, it is the opinion of the writer that any information of importance relative to preventing serious damage to the property should be given to the owner by the department.

I believe that the service pipe should be laid by the water department from the main to the meter and that this pipe should be under control of the department. This is the procedure in Milton. The department lays the pipe to the meter, set either in a manhole, inside the property line, or in the cellar, at the cost of the applicant. This pipe is absolutely controlled by the department. Repairs to it are made free of charge in the street and at actual cost inside the line.

From my experience, I prefer a service laid in this manner: Corporation inserted far enough into the main so that it will at least be flush with the inside of the main; goose-neck lead connection rather than a rigid joint; cement-lined wrought-iron pipe with lead-lined couplings for the service pipe; stop and waste cocks of the plug round-way pattern; and meter connected with brass fittings. Where the pressure is in excess of 60 lb., we recommend setting a pressure reducer on the house side of meter to reduce excessive strain on the piping and fixtures. A pressure of 40 lb. is ample for house supply. Direct pressure should be given the sill cock supply. Some consumers use a so-called water strainer which is intended to intercept foreign material before it reaches the pressure regulator. The principle is good but attention is required or it will cause stoppage of the flow by filling up. The main cellar shut off should, as I have said, be a round way cock, as in case of a frozen service, a compression cock or flat way cock will present an obstruction preventing the insertion of a thawing tube.

It is also a good plan to install a cock or valve without waste on the house side of the meter to prevent siphonage in case a pressure boiler is used, and also to prevent water flowing back over the cellar floor when a meter is being changed or repairs are being made.

Boating and Fishing in Water-Supply Ponds and Reservoirs

By X. H. GOODNOUGH
Chief Engineer, State Department of Health, Boston, Mass.

ONE of the most serious difficulties with which water-works officials and health officers have to contend is the enforcement of necessary sanitary regulations for the prevention of the pollution of water-supply reservoirs. This is especially true of that most serious source of danger which results from the use of such reservoirs for boating and fishing.

If present tendencies continue, unless the public can be awakened to the situation, many naturally pure waters are likely to become contaminated and there is grave danger that in places where the public is now getting the benefit of the very best uncontaminated drinking water recourse will have to be had to methods of purification or sterilization, and the uncertainties of the human element will be introduced in order to make the waters safe for drinking. Where there is now an almost ideal condition as shown by actual death rates for water-borne diseases, an uncertain state of affairs is sure to arise in a field where uncertainties are most to be deplored—in connection with the public health. We may not doubt that with the growth of knowledge of these methods, the public will eventually protest against the use of polluted waters, whether purified or not, when we see the people of Lawrence ready to expend large sums of money to avoid the necessity for drinking the polluted water of the Merrimack River, no matter how well purified it may be.

Year after year bills are presented to the Massachusetts Legislature to authorize boating and fishing on ponds and reservoirs used as sources of water supply, and as time goes on their advocates become more and more insistent in their appeals for such privileges. The Department of Public Health and the water departments of the various cities, towns and districts are constantly urged to grant such privileges.

[Many epidemics of typhoid fever, attributed to the pollution of surface waters were reviewed by Mr. Goodnough. Some of the conclusions based upon this review, together with supplementary arguments follow.—EDITOR.]

1. That a very slight pollution by typhoid fever germs

may infect reservoirs of very large capacity sufficiently to cause great epidemics of typhoid fever.

2. That the typhoid germ can survive the severe winter weather of a northern climate and retain its virulence.

3. That the germ can be carried long distances in water and may survive through many weeks of time.

In some of the epidemics the exact cause was never discovered, and this fact brings up another discovery of modern sanitary science relating to this disease, namely, that there are typhoid carriers, so-called, who though apparently in good health, are capable of spreading the disease.

Furthermore, there are so-called walking cases of typhoid fever—that is, cases so mild that the patient is never obliged to go to bed, and there are others who are infected for a period of several weeks before finally coming down with the disease. Where numbers of persons are allowed to resort to ponds and reservoirs for boating and fishing there will inevitably be carriers or possibly walking cases among them, and the infection of the water supply is not only possible, but probable.

To us in this day the lessons taught by the great epidemics of the past united to those instilled by many lesser ones seem self-evident, but they are very far from being so regarded by the boatmen and fishermen who demand access to water supply reservoirs and by many of the legislators and city councillors upon whom such demands are urged. If through the fatuity of legislative bodies, state or municipal, the policy of the strictest sanitary protection of water-supply reservoirs is broken down or impaired, calamities such as those herein recalled and which now seem relatively remote many easily follow. Furthermore, more memorable and far-reaching consequences may result to those directly or indirectly responsible for such a calamity than was the case in the great epidemics of earlier years when sanitary science in its application to water supplies was less developed than is the case at the present day.

Quicksand: Its Nature, Behavior and Methods of Control

By CHARLES R. GOW
Consulting Engineer and Contractor, Boston, Mass.

CONTRARY to popular impression "quicksand" is not a material but rather a condition of a material, which under different circumstances may possess no such characteristics. Furthermore, quicksand, as such, rarely occurs in nature but usually is artificially produced by the acts of man.

Any material of a granular nature may become a quicksand if there is an upward movement of ground water through it of sufficient velocity to lift and carry the individual particles. On the other hand, no such material will become "quick" in character unless there is such a flow of water. One of the best and most inclusive definitions of the term quicksand which the writer has ever seen was given about twenty years ago by one of our fellow members, Allen Hazen, in a discussion of the subject before the American Society of Civil Engineers wherein he stated that quicksand is "A sand containing for the time more water than would normally be contained in its voids, and therefore, with its grains held a little distance apart, so that they flow upon each other readily." Such a definition is applicable to any material, irrespective of its composition which manifests the conditions and behavior usually ascribed to "quicksand."

The smaller the individual particles of sand are, the easier it becomes for the water to lift and hold them in suspension. Also the voids generally speaking will be smaller and more numerous in this case and the passage of water through them more difficult. The result is, therefore, that fine grained sand displays the quality of "quicksand" much more readily than does a coarse grained material. The writer has seen coarse sand and gravel, however, which displayed all of the characteristics of a "quicksand" under conditions of high velocity of water inflow, but in the main the term is chiefly applicable to sands of extremely fine texture.

[The author presented a number of sketches to show that in engineering construction "quicksand" is caused by unbalanced pressure which may be controlled by sheeting, ordinary pumping, pumping from well points or perforated pipe, and in some cases by sinking a cylinder, placing a small suction pipe in the center, filling between the cylinder and small pipe with sand and then gravel, and finally withdrawing the cylinder. An experience recorded by Mr. Gow and some other practical observations conclude this abstract.—EDITOR.]

It has been the writer's observation that fine wet sand in its normal condition will sustain quite as great a foundation load as will the coarse grained sands. The usual aversion to using fine wet sand as a bearing material has its chief basis, in the writer's opinion, upon the fact that we usually see much sand in its abnormal and not its normal state.

Some years ago the writer had occasion to construct some pier foundations upon coarse wet sand. The test borings indicated a firm layer of sand but when the excavation had progressed to this point it was found by the inspector that he could readily force a rod into the soil for a considerable depth. Because of this apparent instability, he ordered that the excavation should be carried deeper until satisfactory material was encountered. The foreman suspended work for the time being and allowed the ground water to rise in the pit to its normal level. Upon attempting again to demonstrate the soft quality of sand by means of the same rod, the inspector was surprised to find that he could make no impression upon the surface of the sand now that there was no longer an upward flow through it.

A perusal of the building regulations of the several large cities will show that fine wet sand and "quicksand" are allowed bearing values of from ½ to 2 tons, while coarse sands are allotted much higher values. It has been the experience of the writer in making tests upon the fine wet sands that they will carry quite as much load as the coarser sands, provided the ground water stands at its normal level.

The chief danger in using such materials for foundation loads lies in the possibility of future excavations being made in the immediate neighborhood which may be carried to a lower depth than that of the foundations referred to in which case there may be a flow of surrounding soil toward the new opening thus undermining the foundation. Such damage, however, will occur whatever may be the unit loading upon the soil.

The writer has never hesitated to recommend loadings as high as four tons per square feet upon sand which, during the excavation process permitted the workmen to sink to their knees in it. Nor has there ever been to his knowledge, any observable settlement in such cases.

Cinders are also useful during the process of excavating into quicksand for the purpose of maintaining a footing upon which the workmen may stand without sinking into the sand. A frequent liberal sprinkling of this material over the bottom of the trench will be found very effective in preventing miring.

It will also be found in the handling of many quicksands that the ordinary garden fork is more efficient for the purpose than is the type of shovel usually employed. This is due to the fact that fine wet sand has a very pronounced "suction" which causes the blade of the shovel to stick and requires a greatly increased force to remove it.

City Planning Promotion at New Orleans

The Board of Directors of the New Orleans Association of Commerce has voted to endorse efforts being made by one of its committees to secure a city plan for New Orleans, including whatever legislation it may be necessary to secure to put such a plan into effect. Charles A. Farrot is chairman of the City Plan Commission of the association, and Milton B. Medary is city planning specialist engaged by the commission to collect data and to conduct publicity work.

Hoover Discusses National Policy on Engineering Problems

In Presidential Address Before Mining Engineers Urges Profession To Exert Itself in Public Interest

HERBERT HOOVER in his presidential address before the American Institute of Mining and Metallurgical Engineers in Minneapolis, Aug. 26, called attention to some of the engineering problems which are national in scope and can be solved to the best interest of the people of the United States only by the formulation of a national policy based on a broad conception of the influence of these problems in the life of the nation. He believed a department of public works an aid to the study and formulation of such national policies.

His address in full follows:

The time has arrived in our national development when we must have a definite national program in the development of our great engineering problems. Our rail and water transport, our water supplies for irrigation, our reclamation, the provision of future fuel resources, the development and distribution of electrical power, all cry out for some broad-visioned national guidance. We must create a national engineering sense of provision for the nation as a whole. If we are to develop this national sense of engineering and its relations to our great human problems it must receive the advocacy of such institutions at this.

We, together with our sister engineering societies, represent the engineers of the United States. It is our duty as citizens to give voice to those critical matters of national policy which our daily contact with this, the fundamentally constructive profession, illuminates to us. Just as our medical associations voice the necessity of safeguards to national health; as the bar associations safeguard our judiciary, so the engineers should exert themselves in our national engineering policies. We have none, but we need some, or the next generation will face a lower instead of a higher standard of living than ours.

Solution Beyond Individuals

The development of our transportation, fuel, power and water under private initiative has been one of the stimuli that have created the greatness of our people. It has been easy to compass when the problems were more local and filled with speculative profits. There, however, arises a time when this haphazard development must be co-ordinated in order to secure its best results to the nation as a whole. This system has given us a 50 per cent result; if we are to have 100 per cent we must have a national conception and national guidance. This last 50 per cent involves problems beyond individual initiative alone.

Not only is individual initiative insufficient because the problems involve political, financial, interstate matters beyond corporate ability, but we have, with practically unanimous consent of the country, adopted a policy of the limitation of profits in the operation of public transportation and power and some other utilities, and through the pressure of public opinion we are rapidly coming to a limitation of profit in the development of other large sections of national resources which tend to become natural monopolies. While the limitations of these profits makes for public good, on the other hand they also militate against individualistic development of national resources and necessitate the co-operation of the community as a whole to secure initiative for wider development in the national sense.

Certain of our national resources have always been in national ownership, such as waterways. Certain others, such as reclamation, irrigation, distribution of water for power, are rapidly coming under Government control. In others, such as timber, coal, and oil, the possible exhaustion brings their conservation or provision for the nation's future into national concern. In our railway problem national action has until recently been directed wholly to limitation of profits. Latterly it has undertaken to regulate wages and give some small recognition to the necessity of equipment. But microscopic attention has been given to the greater problem of how to get more transportation, to get it so organized as to secure real economic operation in its broad sense.

We have a long list of such problems. Some of these have been discussed before the Institute on previous occasions. I may refer to our discussion of eastern bituminous coal. During the past year the Institute undertook to look into the economic situation of this industry as a national whole. It was demonstrated to be the worst functioning industry in the country. Owing to seasonal and other irregularities of demand, the average term of employment in the bituminous industry is less than 190 days per annum. If this industry could be operated a normal work year 125,000 men could be turned to other production. It is an industry in which 30 per cent more capital is invested than would otherwise be necessary. The cost of coal to the consumer and the risks to the operator are greatly increased, and, above all, it presents a great human problem fraught with all the terrible misery and strikes and justified discontent that flow from intermittent employment.

I am not proposing nationalization of the coal mines; far from it. What is required is that we should realize that with our necessary social view of prohibition of combination there remains a national problem beyond the solution of any individual coal operator or any group of operators. It must have national guidance and national plan for its solution, a co-operation of great consumers, railways, operators and miners—but what individual operator can do this?

In respect to our coal supplies again, if we would look forward to the next generation, we have a problem of conservation of immense importance. In this connection, it has been ably proposed by our members that the national government should co-operate in investigating the possibilities of the establishment of a great electrical trunk line throughout the great power consuming districts of the northeast, and that we should feed into this great power road power generated at the mines and available water sources, drawing from it at every town and city. The consummation of this project means cheaper power to all consumers. It means a great economy in consumption of coal. It means more regularity in output. It thus means greater ability to compete in world manufacture. It means great relief to the railways from expansion. It means an increased standard of living and a decreased cost of living to a very large section of our population. We have again much such a problem in providing adequate power resources upon the Pacific Coast, where today hundreds of thousands of acres of fertile land are practically non-producing for lack of pumping power.

Conservation and Transportation

Of other problems akin to this, we are confronted throughout the west with the fact that a large portion of our average low water supply is already under engagement for irrigation and power. The time has come when that expansion of the land available for cultivation, or into more intensive cultivation, is a factor of mountain storage of water to increase our stream flows in the low season. We have thus a storage problem on a scale we have not hitherto dreamed of, and, again, it is a problem involving co-operation in financial, economic, distribution, navigation—interstate questions, in which individual initiative must have the assistance of the community.

Another series of such problems lies in our oil supplies. If we are to have a mercantile marine and to maintain our navy on a basis of equivalent efficiency with foreign navies, if we are to maintain the development of the gas engine—the greatest lift in our standard of living and saving of labor in fifty years—we are confronted with the necessity of securing additional oil supplies from outside our own boundaries. Our own supplies, so far as now known, do not represent twenty-five years at our present rate of consumption. The Institute many mouths ago was the first to give warning to the Federal Government of the gradual absorption of all of the oil sources of the world by other great

powers, and that within a short time we should be dependent upon the good will of those powers for our necessary oil supplies. No private individual can compete with foreign governments in the measures that they are adopting to hog the resources of the world. This problem again is an engineering problem that requires more than private initiative.

A problem of even more pressing importance than these is the whole question of transportation. Our inability to move the commodities which we create is stifling production. It is increasing the cost of distribution and has placed a tax on the American people in decreased production and increased cost of distribution greater than all the taxes imposed by the war.

We have today in Minneapolis ample proof of the frightful cost imposed on the farmer, consumer and public. There is a premium over freight cost from 10 to 20c. a bushel for wheat at the mill door compared to wheat in the elevator a few hundred miles away, solely because cars are not available. Either the farmer is losing the amount or the consumer is paying it. Furthermore, to carry the picture further, the railways, in endeavoring to remedy this, are diverting cars from the lumber industry. Already certain mills are partially closed; men are thrown out of employment in the mills and in the building trades. Is this not a price in human misery and national efficiency that warrants some national concern? It is a problem that does not lie alone in expansion of railway facilities. It lies also in the proper expansion of waterways and their co-ordination with the railway transportation of the country.

Congressional Waste

We have been dabbling in the improvement of water transportation of the United States for 100 years, and so far as I know never yet have we considered it as a problem requiring complete co-ordination of the entire transport problem for the whole country. We have spent enough money improving useless creeks to have made several competent waterways. Every Congressional district in the United States has looked for appropriations for carrying mud from one hole to another as their proper participation in the national plunder. They have never considered that the taxes taken from the people as a whole should be devoted to those points that will benefit the people as a whole.

One result of the policy pursued has been that our waterways have been so badly handled that they have not been able even to compete with the railways, and today, with an enormous increase in railway rates, we find ourselves utterly unable to handle the great bulk commodities of the country at the possible lower charge over our waterways. The opening of the St. Lawrence to ocean-going vessels means 5c. a bushel to every farmer in ten states. Likewise, of no less importance to the people of the entire country are our internal waterways.

These projects have a simple result in the engineer's mind: they make greater production possible with less human effort; they increase the standard of life; they provide for our children. All these problems are much akin, and the time has come when they need some illumination, guidance, and co-operation in their solution from the Federal Government. Nor do I mean a vast extension of Federal bureaucracy in Federal ownership. If, in the first instance, through an agency of the central government, we could have an adequate study and preparation of plan and method made of these problems of engineering development over the next fifty years, viewed solely in their national aspects, we would have taken the first step toward the adequate provision of an increasing standard of living and a lower cost of living for our descendants.

The second step is to determine that our government will be a government of co-operation, limiting profits surely, but holding to individual initiative as the single hope of human development. In order that we shall have some central point in the Federal government were these problems may be adequately considered, from which they can be ventilated for the verdict of public opinion, where the business brains of the country can be called into conference and co-operation with the government, and therefore with the people, the engineers of the United States have proposed time and again that a Cabinet department should be established in Washington, either new or to replace the Interior Department, to which should be assigned the whole question of public works.

You are familiar enough with the advantages of such a department from an everyday administration point of view, and enormous saving to the government from the duplication or competition of the six or seven departments now engaged in engineering construction work of this character, but on this occasion I wish to call your attention to the fact that such a department has become an essential from the point of view of proper consideration and presentation to the American people of these broader national engineering problems, upon which the next generation must depend if our country is to march forward.

Gravel Plant Record Has Lesson for Contractors

Estimates of Capital Investment, Production Cost and Plant Equipment Based on Analysis of County Outfit

Highway contractors without experience in the production of washed and screened gravel stand in grave danger of underestimating the task of developing local pits to produce small yardages. Records of actual experience by contractors are lacking. The published operating records of commercial and municipal plants are usually incomplete. They may be given a measure of usefulness, however, by analysis. Such an analysis has been undertaken in the article which follows in the hope that it will develop authenticated figures from actual experience. The subject is of growing interest and readers are asked to contribute any information which may help to establish the facts.—Editor.

PIT development to produce washed and screened gravel is not financially a light undertaking. The technical problems also require judgment and foresight in their solution. A screen and washer unit is expensive. The costs of pit preparation and of operating rights are often large. Mechanical equipment for handling material from the pit to the plant may require a heavy investment. A fourth cost, which is exceedingly important, is the wash water supply. Finally, the task of estimating these costs is complicated by the fact that published records of operation, which fit the contractor's requirements, seldom include all the cost items.

On all of these several counts, the experience last year of Wayne County, Michigan, in producing washed and screened gravel from a local pit will repay analysis. Quoting from official records, an article in *Engineering News-Record*, Nov. 27-Dec. 4, 1919, p. 944, gave the cost of the producing plant at $7,200 and the cost of production at 53c. a cubic yard. Later records, permitted by a more comprehensive calculation, change these amounts to $8,000 for plant investment and to 75c. cubic yard for production cost. In neither case may the figures be accepted as true costs under ordinary conditions, because in this installation certain items of plant cost and of production cost either do not appear or were omitted in the calculation.

Equipment

The equipment consisted of rotary screens surmounting and delivering to elevated bins and charged by an inclined belt conveyor from a ground hopper. Its out-

put averaged 200 cu.yd. a day. All machinery was standard and modern. Briefly it consisted of a 1½-in. sizing screen, a jacketed ¾-in. and ½-in. washing screen, a sand settling hopper and an overflow chute. The conveyor was 125 ft. long on centers, and was fed mechanically from the ground hopper. Bins, with chutes, a conveyor trestle and a supporting frame completed the gravel plant as a unit, which was operated by a 15 hp. electric motor.

A small stream fed by local springs provided an abundant source of wash water. The point at which water was taken was ¼ mi. from the washer and was 50 ft. lower than the washer foundations. The height of the screens above the foundations was 30 ft. From suction to delivery, the lift was, therefore, 80 ft. Ordinarily a 4-in. or 4½-in. pipe line would have been installed, but as the County had a quantity of 3-in. pipe on hand it was decided to employ a double line of 3-in. pipe. The friction head in this line amounted to nearly 80 ft. making a total head of 160 ft. A two-stage 5-in. centrifugal pump having a capacity of 400 gal. a minute against 200-ft. head was installed and is operated by a 50-hp. electric motor. In service, the capacity of this plant proved ample but not in excess of the requirements.

Mechanical equipment for excavating the gravel and charging the conveyor hopper was not installed. It was considered that the amount of gravel, about 10,000 cu.yd., required for the construction which was contemplated, did not warrant the investment cost. Four teams and scrapers, with four drivers and two scraper holders, were employed. This outfit cost $42 a day in wages or 21c. a cubic yard based on a 200 cu.yd. output.

Plant Investment

In round figures the plant investment was $8,000. This cost included all the machinery of the washing unit except the motor; all the water supply outfit except the motor; ¼ mi. industrial railway incline into the pit, and certain other expenses of pit preparation, but not the pit investment cost. Two facts are to be noted.

Motor costs are not included in the $8,000 investment cost. A 15-hp. motor was required for the washing plant and a 50-hp. motor for the wash water pump. It was possible in this instance to rent the motors and electric current was available at a moderate cost for connections. Ordinarily the investment cost of $8,000 would be increased by the cost of the power units and of making the necessary line connections, if electric motors were used.

The second fact to be noted is that about $800 of the plant cost given was required for pit development and preparation, exclusive of the producing equipment. This expenditure was required in a pit which had been worked and for which, therefore, a portion of the development investment had been made. It does not include the cost of gravel in place. In this instance a pit rental of 15c. a cubic yard was paid and was charged to operating expense. However it may be distributed, the fact to be grasped is that there is always this pit cost, either a straight purchase price or a rental charge in some form, and it must be entered in an appraisal of the cost of developing and outfitting local gravel supplies.

Reverting to the production cost of 75c. a cubic yard, it is essential to observe that this cost does not include interest on the investment nor depreciation. Neither does it include any overhead charge of the county road department nor any charge for general superintendence, insurance, etc. An additional qualifying fact to be observed is that the pit-run gravel is nearly of the proper composition for concrete aggregate and, therefore, there was practically no charge for waste. On the other hand, this 75c. production cost includes a pit rental charge of 15c. per cubic yard.

Having the broad facts concerning the Wayne County gravel plant as stated, general conclusions are possible concerning plant requirements, capital investment and production cost. Warning is called against applying these conclusions to specific cases. They are merely indicative of general facts.

1. Except possibly in one particular, the plant described meets the requirements of pit development for a single-output concrete paving operation. A small steam shovel and cars or a light cableway dragline would have reduced the cost of excavating and handling gravel to the washing plant, and for a greater total output than 10,000 cu.yd. would certainly prove a justified investment. One fact to be noted attentively is the magnitude of the plant for supplying wash water. This is emphasized because to the inexperienced pit man the volume of wash water required by even a small gravel washer is surprisingly large.

2. The capital investment for the plant described is given at $8,000. The costs of 1920 for the same equipment would be more. Including the cost of motors, which in this instance were rented, at $20 per horsepower for one 15-hp. and one 50-hp. machine, we have an additional investment of $1,300 or say $1,500, including installation costs. A dragline of any of the commercial types, say a ½-cu.yd. bucket with a hoist equivalent to a 7 x 10-in. double drum steam hoist, would add from $3,500 to $4,000 to the amount already given. The costs given are low yet they aggregate $13,000 even when using the smaller figures for each item. Roughly, a pit producing daily 200 cu.yd. of washed and screened gravel, calls for a capital investment of never less than $10,000 and often as much as $15,000.

3. The production cost at the Wayne County plant is given 75c. a cubic yard including 15c. a cubic yard pit rental. On the $8,000 investment the interest charge at 5 per cent would be $400 and the depreciation at 20 per cent would be $1,600. Based on a season's output of 10,000 cu.yd., the interest and depreciation charge would be 20c. a cubic yard. Adding reasonable charges for overhead cost, insurance, waste, etc., the cost reaches well over $1 a cubic yard.

4. Even at the production cost finally arrived at, the Wayne County gravel plant was highly profitable. At Northville where the plant is located, commercial pebbles in 1919 cost $1.25 a ton on railway cars. It cost about 25c. a ton to unload the railway cars into industrial cars. At $1.50 a ton the cost per cubic yard was $2.25. Besides this direct reduction of cost there was the indirect saving of possessing always the constant supply of aggregates at a time when car shortage and other transportation restrictions made continuous supply by railway a practical impossibility.

British National Debt

The total British national debt was reduced £234,000,000 from December 31 to June 30 last, the new total being £7,845,000,000 ($38,177,700,000 at normal exchange).—*Commerce Reports.*

Hydraulic Fill at the Miami Conservancy Dams—II

Improved Sump and Pump Layout Reduces Losses of Head at Suction—Manganese Steel Doubles and White Iron Quadruples Pump Output Life

By C. S. Hill
Associate Editor, *Engineering News-Record*

With one minor exception of 150,000 cu.yd. of fill placed by direct sluicing the placing of hydraulic fill is entirely a pumping operation. Plant location and design and pump construction and operation assume great economic importance, therefore, under any conditions. Having to pump a heavy glacial gravel containing stones up to 6 in. size, causing great wear and developing high friction heads, complicates the conditions and raises pumping practice to nearly paramount economic importance. Intensive study has therefore been given to all factors and improvements of exceptional economic worth have been developed.

Plant Location—So far as a common plan of pumping plant location could be contemplated for all five dams of the Miami Valley flood-protection works this plan has been to place main pumps at the toes of the embankments and as the fills are built up to assist the main pumps with booster pumps at higher levels on the discharge pipe lines. Actual practice exhibits a conformity with and a variation from this common plan which are determined by the local conditions at each dam.

On the plans of Fig. 1 (*Engineering News-Record*, Sept. 9, p. 487) the circles and the arrowheads indicate approximately the locations of the main pumps and the directions of the borrow pits. At three of the dams one location of the main pumps satisfies the requirements of convenience to the borrow pit and of moderate average lengths of discharge pipe line for the entire hydraulic fill operation. Under 1,500 ft. is the average distance of discharge at these three dams. The character of the borrow pit is instrumental in the three changes of pump location at Taylorsville. Here the borrow pit is a long and narrow side hill cut required to clear the earth overburden from the rock cut for the outlet channel (*Engineering News-Record*, July 29, 1920, p. 196) and the pump sumps have been shifted along the toe of this cut as conditions required.

Changes of pump location at Englewood record the effort to keep down the friction heads by hauling the material by train to higher elevations before delivering it to the pumps. Sump 2 is 33 ft. higher than Sump 1 and Sump 3 is still higher by 17½ ft. The 1919 fill was made from Sump 1 and pumping is in progress for the 1920 fill with both No. 2 and No. 3 locations, from the former for raising the 1919 fill to elevation 850 and from No. 3 to fill the channel section. Cross dam 1 has been carried up to elevation 850 to make separate pools.

Sump Design and Pump Layout.—For the sluicing operations at Lockington and Taylorsville, sump construction has been little more than a pit, walled in and provided with a grating. At the hog-box installations for the other three dams more elaborate sump construction has been undertaken. With the changes of pump location at Englewood a development has taken place in sump design and pump layout by which smoother operation and larger outputs have been secured.

In the original layout at Englewood, shown by Fig. 4, the sump for each pump was an 8 x 8 x 10 ft. concrete box with a pyramidal false bottom of timber. The pumps were set above the sump water level, took their suction through pipes inclined 45 deg., and delivered their discharge horizontally to the toe of the embankment, where a 25-deg. elbow shifted the direction up the slope of the dam. As practice has prevailed in the past, this layout was successful, but operation revealed a number of faults:

(1) Because of the shape of the sump the solids dropped to the bottom and formed an inert mass from

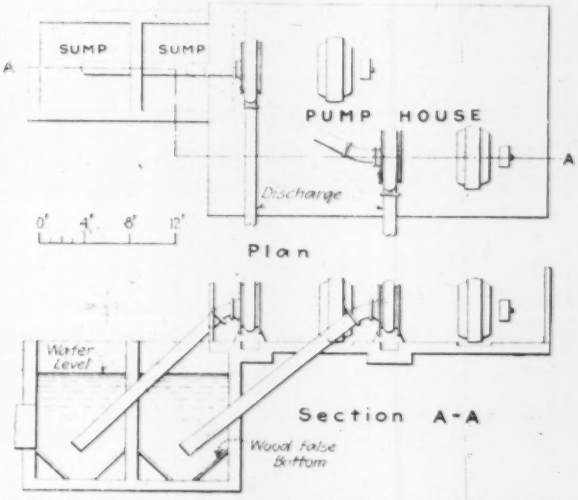


FIG. 4. ORIGINAL LAYOUT GAVE HIGH SUCTION HEADS

which they had to be sucked up by the pump. In case the delivery from the hog-box was rapid the solids piled up and then suddenly sloughed down and buried the end of the suction which condition caused some danger of plugging.

(2) The suction was not efficient. The pumps had suction lengths of 18 ft. and the center of the suction as it entered the pump was 7 ft. above sump water level. The pump while operating showed as much as 16 in. of vacuum, equivalent to 18 ft. head. The loss of head in the suction pipe was therefore about 11 ft., maximum. This was due in part to velocity head and in part to friction in the pipe because of its length and curvature and the shape of its suction end, which was square cut.

(3) There were priming troubles. Ordinarily the priming operation was simple, but occasionally sand would collect in the injector and it had to be cleaned out. In the aggregate, delays due to priming amounted to a considerable loss of time.

Uneven feeding of the solids and danger of choking the suction were alleviated to some degree by the installation of the rotary screen previously described, but with the installation of layouts Nos. 2 and 3 a

fundamental change in design was undertaken as is indicated by Fig. 5. In this new layout the pumps are set 8 ft. below sump water level; the suction pipe is straight and horizontal and only 5½ ft. long; a bellmouth suction end reduces contraction of the entering jet and the pipe supplying water to the sump delivers its flow in direct line with the suction. Between the delivery end of the water supply pipe and the bellmouth of the suction the bottom of the sump has the form of a 21-in. circular trough, the theory being that the current from the delivery pipe continues through this trough into the suction pipe and the solids from the rotary screen are

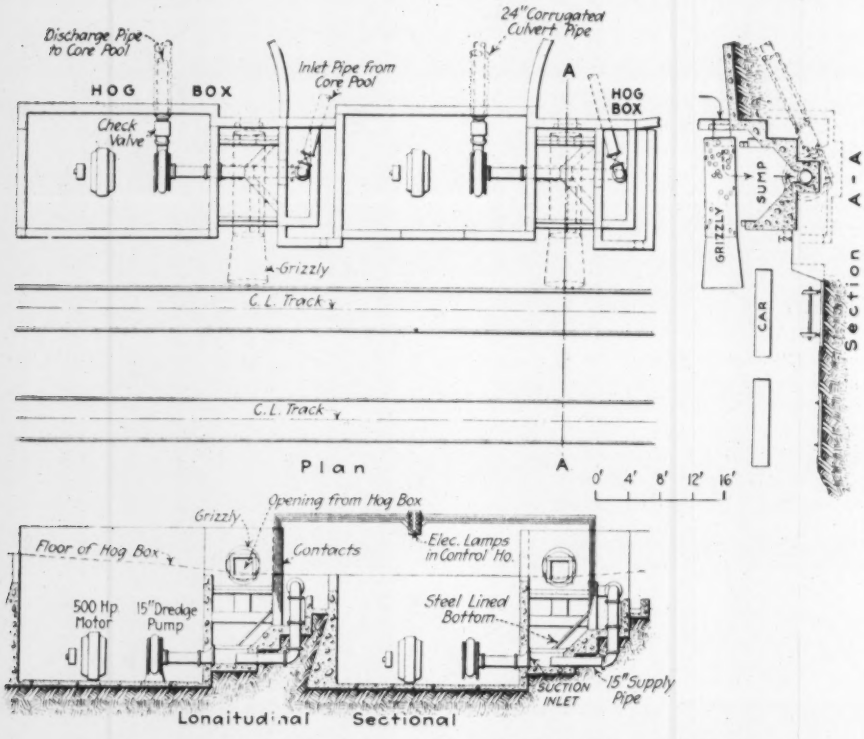


FIG. 5. IMPROVED SUMP PLACES PUMPS UNDER PRESSURE

fed into a living stream of water, which conserves to some extent the velocity with which it issues from the supply pipe.

With the new layout, loss of energy at the pump suction has been more than cut in two. Another saving of head is secured by setting the line of discharge of the pump at an angle of 27 deg. from the horizontal. By this inclination the discharge pipe leads off from the pump in a straight line up the slope of the dam. Considering suction and discharge together, the only deviation from a straight line occurring in the travel of the pumped material takes place in the pump itself or is incidental to the pumping action.

Sump design and pump layout considered for all dams permit of general conclusions as follows: (1) Placing the pumps under pressure from the sump, as in the final layout at Englewood, with the straight line suction and discharge pipe arrangement, is a material improvement in which the continuing current of water from supply to suction through the trough-shaped sump bottom is perhaps a contributing factor; (2) overloading the sump, with consequent choking of the suction, is an always imminent danger which has to be eliminated. Means are provided by the rotary screen feed to the sump when it is practicable to install this device. Likewise a slip-pipe suction (*Engineering News-Record*, July 29, 1920, p. 234), as installed at Lockington, helps to meet the danger; (3) access to the sump and the suction is sufficiently important to warrant the construction of the sump so that it can be drained, even if to do this it is necessary to pump the supply water; (4) in general sump design has not set the limits of pump output; it has been set by the ability to bring the materials to the sump continuously in the required volume.

Pump Construction and Service.—Pump construction has followed a development from the regulation commercial product to the high-durability centrifugals now in operation. While the process of improvement is still going on it will for the future consist in refinements of detail. The broad steps in advance have been made. Briefly characterized, they are strides toward a much longer output life of dredge pumps.

A 15-in. pump was adopted as the standard for all the hydraulic fill operations. The determination upon this size was influenced by two main facts: (1) A 15-in. pump will build up the embankment about as fast as it seems likely that hydraulic fill should advance and be certain to settle and dry to solidity; (2) a larger pump would have materially increased the difficulty of water supply and disposal. The pumps are electrically operated by 500-hp. motors at Englewood and 350-hp. motors at the other dams. The Englewood and Lockington installations have two pumps, not including boosters, and the other locations have one-pump installations.

The first pumps installed had cast-iron shells and runners, which had a life in pumping the heavy glacial gravel of about 12,000 cu.yd for the runners and about 160,000 cu.yd. for the shell. The first development was to substitute cast manganese steel, probably about 5 or 6 per cent manganese, for the runners. These runners show wear at about 50,000 cu.yd. and can be used for 100,000 cu.yd., but with doubtful efficiency as this age is approached. Later a full manganese steel pump was adopted and this gives a shell wear of between 180,000 cu.yd. and 200,000 cu.yd. with a shell thickness of 2½ to 3 in.

Shell wear in the manganese steel pumps does not pierce the metal; instead, after the shell has become thin, it splits circumferentially. Repairs of split shells by placing U-shaped clamps at intervals and riveting a plate to the inside, suggested a shell design which involves U-shaped ribs as an integral part of the casting, the theory being that the ribs will hold the shell from splitting until it wears much thinner than it has been

wearing before it has split. In this new design increased thickness of shell was also sought. To increase the shell thickness was difficult if manganese steel were used. This coupled with the cost of 26 to 27c. a pound of the alloy steel led to experiments with white iron at a local foundry. A shell of white iron from 4 to 5½ in. thick, with seven reinforcing ribs, has been cast and installed. In pumping 150,000 cu.yd. at Germantown this shell has shown a wear of not over ½ in., which indicates an estimated life of about 400,000 cu.yd.

Experience with impellers has led to three accepted practices, besides changing the metal from cast iron to cast manganese steel: (1) Compensation for variations in head by using runners of different diameters; (2) use of removable shoes and (3) scrapping the runners or shoes as soon as a reduction in efficiency due to wear begins to be evident. With the pumps working against constantly increasing heads, as from 25-ft. to 150-ft., for example, power is economized by increasing the diameter of the impeller as the head increases. A 38-in. and a 42-in. runner have been adopted as standards. The smaller runner takes a 38-in. and a 40-in. shoe and the larger takes a 42-in., a 44-in. and a 46-in. shoe. The renewable shoes not only keep the runners longer in service but also accomplish the very important object of maintaining the pump at high efficiency. A quick change of shoes when the efficiency begins to drop down because of wear restores the runner to its original efficiency. Experience has disclosed that there is no economy in keeping a badly worn pump in service, and the practice, generally speaking, is to discard the worn impeller as soon as a material decrease in efficiency due to wear is evident.

Control of Suction and Flow.—Maximum output is realized when there is a steady flow, to the capacity of the pump, of solids into the suction and out of the pump through the discharge pipe line. Unless this condition is realized the pump is operating below capacity, or is operating under an overload with the possibility imminent of a choked suction or a plugged discharge. It is therefore of the utmost importance that the pump operator shall be continually informed as to the conditions of flow, with particular reference to the load of solids which is being carried. On the flood control dam operations three methods of furnishing the operator with this information have been employed.

(1) The first method, as it was employed at Englewood, involved a control tower overlooking the sump feed and screens. In the tower there were pressure and vacuum gages, an ammeter, a telephone line to the end of the discharge pipe and electric bell connections to the monitor men and the pump men. Watching his gages and receiving telephone information of conditions at the end of the discharge pipe, the towerman could signal for faster or slower feeding from the hog-box or for more or less power on the pumps. The weak factors were that the operator could not see clearly the water level in his sump and that the gages did not act swiftly and surely. In particular, a plug in the discharge or suction pipe could get under headway before the gages would indicate that it had started, and then frequently the information was too late to be of much value.

(2) An electric indicator, Fig. 6, met the requirements of quick information of the start of the plugs in the discharge pipe. Its operation is based upon the fact that the first sign of plugging is manifested by

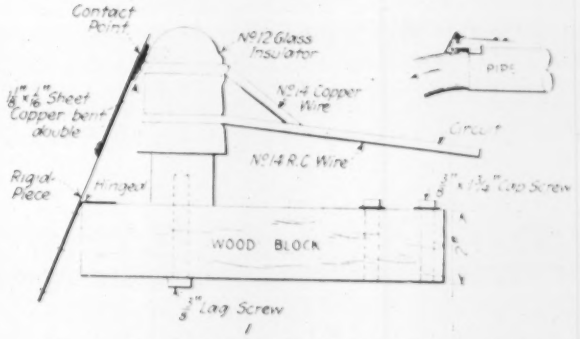


FIG. 6. FLOW INDICATOR ON DISCHARGE PIPE

a reduction in velocity of discharge. The mechanism is a steel clapper working on a hinge and forming contact at one end with an insulated wire running to the pump house and at the other end with the jet from the pipe. With a full jet, double contact is had and the circuit is closed, and when the jet fails the top contact breaks and opens the circuit. Lights on the circuit, one at each monitor and one at the pump, indicate to the operators when the flow is being checked by an incipient plug and they check the rate of feeding solids to the sump and throw more power onto the pump to meet the condition. Objections to this indicator are that it requires long electric circuits and has to be removed and reset for each new length of pipe added. Moreover, the indication is not quantitative; it shows that the flow is greater or less than that for which the flapper is adjusted, but how much greater or less it does not tell.

(3) Regulation of flow through control of the water level in the sump is the latest development. This was accomplished at Germantown, and later at most of the other dams, by giving the pump operator a clear view of his sump. The size of sump is made such that the water level responds readily to the demands of the pump. In operation the valve in the supply pipe is opened to the point giving the proper flow as determined by trial. With an equal feed of solids from the hog-box a speeding up of the pump causes a corresponding lowering of the water level in the sump. Conversely, decreasing speed of the pump causes the level of the water in the sump to rise. With a constant speed of pump increased feed of solids from the hog-box causes the water in the sump to rise and decreased feed allows it to lower.

In actual practice the pump operator knows that if the water in the sump rises and the pressure gage shows increased pressure at the same time that the ammeter shows decreased electrical current his discharge line is being heavily loaded. If, on the other hand, the water level in the sump lowers while the pressure gage shows decreased pressure and the ammeter indicates increased power consumption, then he knows that the pump is handling less solid material. A warning device based upon these phenomena has been installed at Sump No. 3 at Englewood, where the operator cannot see his sump direct. It is necessary only to keep the pump man continually informed of the fluctuations of the water level in the sump and with his gages he can tell for a certainty what is taking place. The immediate warning comes from the water level in the sump; the gages simply explain the cause of the fluctuation.

It was found by trial that the fluctuations of the water level in the sump for ordinary working conditions are confined to the top 2 ft. When the sump is full danger of a plug is impending; when the water level is 2 ft. down from the top the pump is not handling all the solids of which it is capable and it is up to the monitor men to sluice in more material. (In practice the monitor men have instructions to flush the material into the sump as fast as they can unless warned off by the pumpman). It was decided that indications of the water level should be shown to the pumpman at 6-in. intervals. To do this at Englewood, where direct view of sump is cut off, No. 0 gage solid copper wires ¼ in. in diameter are suspended vertically, the bottom of one being at the level of the top of the sump, the bottom of another being 2 ft. below the top of the sump, and three others ranged equally between. These wires are connected in circuit with incandescent bulbs in sockets on the control board in the pump house, one above another in the same relative positions as the terminals to which they are attached. To protect the eyes of the pump runner from the glare of the lamps they are incased in a box with a ground glass front, the top compartment being red to indicate the danger warning. The top circuit is also connected to a lamp on the giant to give the monitor man warning when the sump is full and feed should be slackened. The arrangement of this device is shown in Fig. 5.

Booster Pump Practice

In their essential dimensions and in their construction booster pumps and main pumps are alike. Practice in the location of the booster pump varies. At Lockington the booster is set between the two main pumps on the same floor and is connected up to work with either main. At Huffman the booster pump is located straight up the dam slope from and 15 ft. higher than the main pump. Later two boosters will be used set higher and farther along on right and left discharge pipes from the main pump. At Germantown the discharge line from the main pump extends diagonally up the embankment slope and the booster is located on this line at an elevation 42 ft. higher than the main pump. At Englewood and Taylorsville booster pumps have not yet been installed. The pumps as located have all performed the required work, but further than this statement conclusions are not available.

The problem of synchronizing main pump and booster pump operation has been simply solved by installing at each pump an adaptation of wattmeter in addition to the ammeter and the vacuum and pressure gages. If, for example, the main pump operates on three fingers of the switch board a portion of the current shunted through the wattmeters swings their pointers to mark three. Should a heavy rush of solids require the operator of the main pump to throw down another finger the added current swings the pointers to mark four and the booster pump operator, observing the change, synchronizes his pump with the main pump by throwing down his fourth switch finger. With reasonably alert operators this method of synchronization has been satisfactory.

So far as observed booster pumps show no differences from main pumps in wear or operating troubles. At Huffman it has been felt that the condition of pressure on both sides of the booster has somewhat increased trouble from sand in the bearings, but this trouble has not been pronounced.

Pump Outputs.—Pump outputs which fairly represent pump capacities have been recorded only during isolated short periods of operation. In general it has been impracticable with the means employed to bring to the sumps all the yardage that the pumps were capable of handling. At all dams the pumps are operated two 10-hr. shifts a day.

At Englewood, where two pumps have been operated, and where the highest yardage records have been made, a maximum of 148,000 cu.yd. have been pumped into embankment in a month. In one run of 8 hr. 48 min. one pump averaged 522 cu.yd. per hour, and in another run of 4 hr. 51 min. one pump averaged 576 cu.yd. per hour. These are high records. At Germantown, operating one pump, the rate of fill has been about 60,000 to 70,000 cu.yd. a month. In one month the output was boosted to 91,500 cu.yd. and in another month, January, 1920, due to cold weather, it dropped to 42,500 cu.yd. Under good weather conditions about 60,000 to 70,000 cu.yd. per month is being recorded at Lockington and at Huffman.

[*Part III, in next week's issue, will consider pipe friction and wear and embankment building. All work is being performed by the construction department of the Miami Conservancy District, Arthur E. Morgan, chief engineer; Chas. H. Paul, assistant chief engineer, and C. H. Docher, construction manager. Much credit for the success of the hydraulicking operations is due to the division engineers at the dams. All of them have given caerful thought and study to the problems encountered and have made valuable suggestions for improvements in design. They are: Arthur L. Pauls, Germantown; H. S. R. McCurdy, Englewood; Barton M. Jones, Lockington; O. N. Floyd, Taylorsville, and C. C. Chambers, Huffman. G. L. Albert, hydraulic engineer, has given special attention to the hydraulic fill installations and operations at all of the dams and S. M. Woodward, consulting engineer, has offered valuable advice and suggestions.*]

Increase in 1919 Building Operations

Complete returns made to the U. S. Geological Survey from the building departments of 141 of the larger cities of the country show a large increase in building operations in 1919 compared with 1918, according to a recent bulletin issued by the Geological Survey. The building operations in these cities in 1919 cost $1,302,998,607, as against $430,014,365 in 1918, an increase of 202 per cent. Much of this increase is due, of course, to the increase in the cost of labor and materials, but this does not cover all of it, for the number of permits for buildings increased from 210,538 to 362,811, or 72 per cent. The average cost per permit or building increased from $2,042 in 1918 to $3,591 in 1919, and the average cost of new construction increased from $3,309 in 1918 to $5,088 in 1919.

An interesting fact brought out by the Geological Survey's report is the large proportion of wooden buildings erected even in the larger cities, where, it may be expected, structures of such material would be limited by local regulations. Wooden buildings represented 67 per cent of the total number of classified operations in 128 of these cities, 73 per cent of all new operations, and 69 per cent of all additions, alterations, and repairs

New Concrete Conduit for Denver Water Supply

Old Wood Stave Line Replaced by Concrete Pipes Made on Ground from Local Material— Self-Propelled Pipe Layer

ONE of the first construction moves found necessary by the City of Denver after acquiring the water plant from the Denver Union Water Co. late in 1918 was the replacement of certain wood stave flow-lines. Conduits Nos. 1 and 3, 30-in. and 40 in. in diameter, 30 and 18 years old, respectively, were found near the end of their lives and in need of continual repairs of breaks to keep them in service. For three days in 1919 the consumption exceeded the total conduit carrying capacity. In consequence any serious breaks necessitated drawing heavily on the single day's storage within the city.

Late in 1919 plans were prepared to replace 48,000 ft. of conduits, Nos. 1 and 3, with a 54-in. reinforced-concrete conduit. A contract was let Oct. 31, 1919, for 10,000 ft. with a provision that the city might order the laying of the remainder or an additional mileage of the pipe when the 10,000 ft. was finished and money became available. Other than local points of interest in this new line are (1) a change of policy as to type of conduit from wood stave to concrete, (2) a pipe making plant at the center of the line utilizing aggregate obtained on the ground, (3) a self-propelled pipelaying machine.

Choice of concrete rather than cast iron was based on cost and the impossibility of obtaining cast iron in the time and quantities needed. Wood stave at the time the estimates were made was one-half as expensive as concrete for the same carrying capacity. Some of the wood-stave lines 30 years old are still in service, although reduced in thickness to a mere shell, but another line, laid only four years ago, has reached practically the end of its usefulness without extensive repairs. Although poor lumber might be accountable for localized breaks, there were places found by the engineers where one side of the pipe would be entirely sound and the other side so far gone that staves could be punctured readily by hand with a nail. Alkali or some other chemical in the soil was considered the cause of this condition, but repeated examinations of the soil failed to indicate any areas having a specially high alkali content.

In addition to the uncertain durability of the wood stave pipe, the Board of Water Commissioners was of the opinion that a municipality should adopt as permanent a construction as practicable. Freight congestion and the delay incident to transporting materials were factors in the selection of the type of conduit, since the time element was important, the engineers and members of the board wishing to minimize the chance of a serious water famine.

The location of the new line follows closely that of conduit No. 3 on a 100-ft. right of way paralleling the Colorado & Southern R. R. for the whole distance. This greatly facilitates the distribution of the pipe, since the traffic of this narrow-gage railroad is not heavy and pipes can be unloaded opposite the point of laying.

A central location for the pipe making plant was found near an elevated bank of gravel on the opposite side of the Platte River. Switch tracks were run from the railroad and connection with a crushing and screening plant was made by a 750-ft. aerial tramway across the river. This tramway is shown in Fig. 2, and the pipe yard plant in Figs. 2 and 3. Gravel is pulled into a hopper feeding the cable buckets by a ½-yd. ox-bow scraper operated by a 9-hp. hoisting engine. The cable-way is driven at a speed of 300 ft. per minute by the engine that operates the crushing and screening plant. The elevation of the gravel bank is such that the three cableway towers are about 20 ft. high and permit the buckets to discharge into the crushing and screening plant 18 ft. above the ground. Because of the swampy condition and the nearness to ground water all equipment had to kept well above the surface.

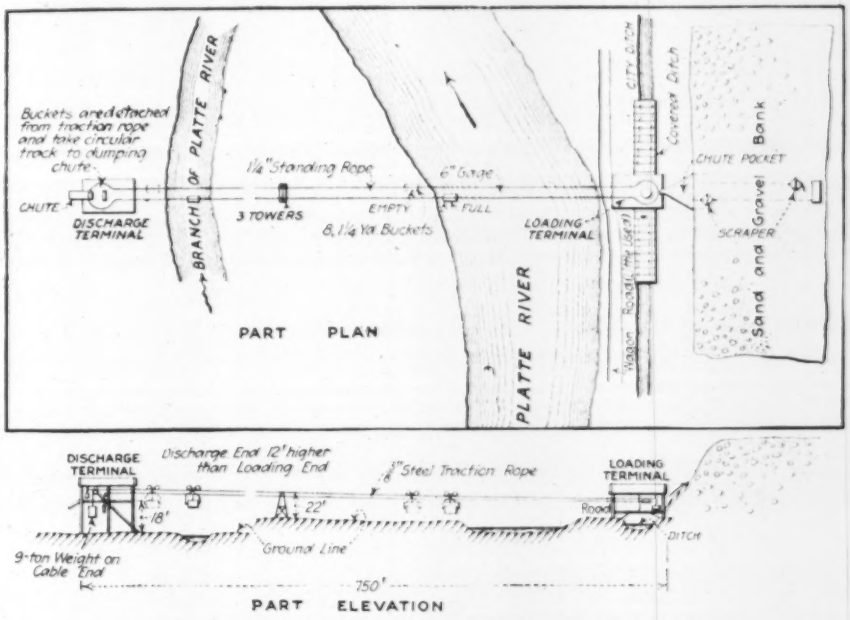


FIG. 1. AERIAL TRAMWAY HANDLING SAND AND GRAVEL

A 1½-in. rotary screen 5 ft. long receives the gravel, the rejections passing to a jaw crusher set to produce 1 in. stone. Material which passes the screen, together with the crusher discharge, is fed by a screw conveyor to a flat screen, the upper 2 ft. of which has a ½-in. mesh and the lower 6 ft. has 1-in. holes for the large aggregate. The rejections from this 1-in. screen are returned to the crusher. Thus everything is finally graded, although a few stones may pass the crusher a number of times. The sand is further reduced by sand rolls located at the upper end of an inclined belt over the stock pile. The resulting sand is exceptionally well-graded up to ½-in. size. Its six per cent clay content has a distinct advantage in producing watertight concrete.

FIG. 2. ELEVATED GRAVEL PIT (IN FOREGROUND) IS CONNECTED TO PIPE YARD BY AERIAL TRAMWAY

Wheelbarrows convey the sand and gravel aggregate from the stock pile to four mixers of 10 cu.ft. capacity located in a row under an elevated cement shed. Cement is hauled up inclines at each end of the shed by a gas engine. Two mixers serve one side of the double casting yard. They discharge into a flat storage pan feeding 1-yd. conical buckets. The pan is made so flat that the men must work out the concrete, thus giving a second mixing. In effect a third mixing is given when the conical buckets are discharged. Batches of only 3½ cu. ft. are mixed and the mixers are inclined to accentuate the mixing action.

A steel gallows frame mounted on a 10 x 10-ft. portable platform propelled by a 30-hp. hoisting engine has a cantilever head piece, the outer ends of which are directly over the centers of the forms for the pipes. This traveling crane, which was used formerly on the Winnepeg aqueduct work, moves at the rate of 600 ft. per minute. Each 10-ft. pipe with 5½-in. shell contains 3 cu.yd. of concrete. In the regular schedule, operations on twenty pipes are carried out each day. In the morning forms are removed from the previous day's pouring. Twenty pipes three or four days old are turned and rolled onto the skids. Inner forms, cages and outer forms are set, and the copper expansion joints (held in spiders) are placed. Pouring is done usually in the afternoon. Every operation is in duplicate and is carried out by the traveler.

The general layout of the pipe-casting yard is shown by Fig. 3. It consists of a double row of casting slabs flanking the 8-ft. track on which the traveling crane runs, with 40-ft. skids of 6 x 8-in. timbers on short piles outside of the slabs, the skids being elevated so that the pipe can be rolled directly onto flat cars. The rolls for bending the reinforcing and the mandrels on which the steel cages are put together are located at

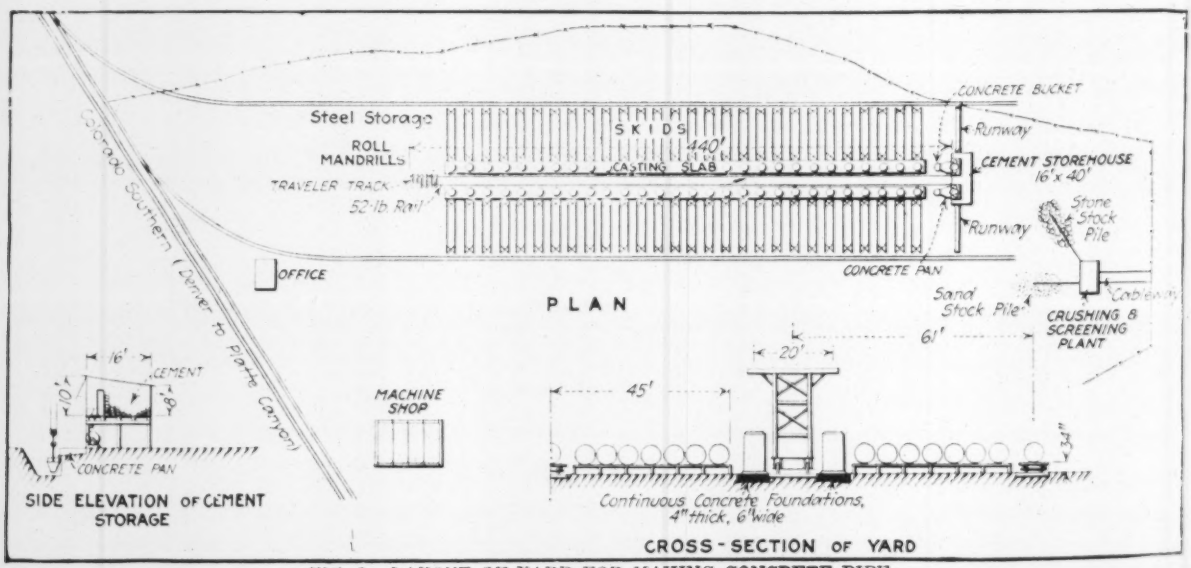


FIG. 3. LAYOUT OF YARD FOR MAKING CONCRETE PIPE

one end of the yard, between the two switch tracks. Seven men are employed in putting the cages together and can turn out twenty cages in a day. The supply is kept only one-half day ahead of the pipe pouring.

Each pipe after pouring is covered with a canvass jacket and steam is admitted to keep the concrete warm and moist and to hasten setting. Steam is left on for three nights during warm weather and the pipe are turned and rolled onto the skids in three or four days. Forms are removed in 24 hours. Twenty forms and 60 bases are provided, everything being in duplicate. In 15 days the pipes are delivered to the trench, where several weeks usually elapse before they are used. No sprinkling is done, as the density of the 1:1½:2½ mix after the steaming effectually holds sufficient moisture for the final crystallization.

The pipelaying machine, Fig. 4, consists of an A-frame derrick with a bull-wheel mounted on a portable platform 24 ft. square on which is a 40-hp. steam hoist propelling the platform forward and back over a track consisting of three sections of 32-ft. 80-lb. rails spiked to 8 x 18-in. sills. The hoist also operates lines from the ends of booms lashed to each side of the platform frame. As these lines are used only for dragging the track sections forward, the booms extend 18 ft. in front. The 40-ft. boom from the A-frame is a 16 x 16-in. trussed stick and extends to the rear. A 3-in. shaft across the front of the outfit has a niggerhead on each end for handling the lines of the forward booms. When the track sections have been moved ahead as far as possible by the niggerrheads the rope from the end of the boom pulls the section half a length forward until a clamp can be put onto the center of the rail, the section being then swung forward to place.

So much difficulty from irrigation and river water was anticipated by the contractors bidding on the work of trench excavating in the swampy, gravelly ground that the city concluded to do the excavation and backfill. Six 4-in. centrifugal pumps belt-connected to gas engines were provided. Except when the whole area was under water from river floods, these pumps have been able to keep down the water in the trench without difficulty, although seldom less than three pumps are in operation. Both excavation and backfill are done by ½-yd. excavators, using a ditcher scoop for the former and a skimmer scoop for the latter. Where the trench passed through swamp muck it was made with 3½-ft. cut and 1½-ft. cover. The slopes on the embankment are 1½ to 1.

Pipe joints are made with copper expansion joints. The pipe is laid directly on the natural gravel, which is worked under the pipe while it is still suspended. Soon after the pipe is laid the invert joint or the lower one-third of the joint is filled with 1 to 1 mortar, care being taken to see that the copper overlaps the wire mesh extending from the spigot end of the abutting pipe. Before the balance of the joint is made backfilling by hand is carried up 1 ft. above the top of the pipe. After this primary joint has set and the pipe has had time to take settlement the secondary joint, on the inside of the pipe, is made with finely ground neat cement mortar placed with a trowel.

Tests under a 125-ft. static head, being that due to the elevation of the water in the clear water basin of the slow-sand filters at Platte Cañon, are called for after the line is in place.

Gate valves and blow-offs are set every mile. Where there is no chance to place a blow-off, manholes are provided from which the line may be dewatered by pumping. Manholes are vented through air valves and are cast monolithic with the pipe, the reinforcement being attached to the manhole casting. To admit air when draining the line, 4-in. ppies are set at each manhole in addition to the regular air valves.

FIG. 4. PIPELAYING MACHINE CROSSING A RAILWAY

The work is being done by the board of Water Commissioners, for which W. F. R. Mills is manager. Designs were made and construction is being carried out under the general direction of Burton Lowther, chief engineer and general superintendent. T. J. Lahey is resident engineer in charge. For the Lock Joint Pipe Co., which has the contract, the work is in charge of J. C. Mitchell, general manager, and P. H. Gentz, superintendent.

Great Falls Development Might Block Railroad Route

THAT the right of way of the Chesapeake and Ohio canal is being considered as a low-level railroad route was revealed at the hearing before the Federal Power Commission on the Great Falls project. Objection was raised to any system of dams on the Potomac, near Washington, which would occupy the entire river basin. It was argued by Lafe Pence, a former member of Congress, that the canal, when filled in, offers the ideal short line route from the coal fields to tide-water on Chesapeake Bay and would give an outlet to the Western Maryland, the Norfolk & Western and the Cumberland Valley railroads and would increase the capacity of the Baltimore & Ohio R.R.

Representatives of the Pennsylvania Railroad explained at the hearing that present conditions preclude any thought of transition from steam to electricity for its lines in the Washington region. It also was stated that no thought is being given to any plan for the electrification of the terminal at Washington.

The development of Great Falls was urged at the hearing by representatives of the civic organizations of Washington and by witnesses from near-by sections of Virginia and Maryland. Representatives of the Potomac Electric Power Co. opposed development of the Falls on the ground that it is not commercially feasible. The uncertainty injected into the power situation by proposals to develop the Falls is having an adverse effect on the power company, it is stated, which is called upon to provide $1,000,000 annually in extending its steam plant to accommodate the increasing power needs of Washington and vicinity. Col. Charles W. Kutz, engineer commissioner for the District of Columbia, told the Power Commission that Great Falls should be developed.

Concrete Track Ties and Electric Poles in China

High Cost of Wood and Low Cost of Labor Make Concrete Economical — Rods in Poles Form Lightning Conductors

By Donald F. McLeod

Formerly of Chinese Government Engineering College

REINFORCED concrete railway ties and electric transmission poles are used by the Kailan Mining Administration of China, and the following information was obtained during an inspection of the process of manufacture through the kindness of L. Demaret, assistant engineer in chief, at Tongshan.

Several thousand ties of the type shown in Fig. 1 have been made and some of them have been in use under heavy traffic for four years. The reinforcement consists of old wire cable which has outlived its usefulness for hoisting at the mines. It is not believed

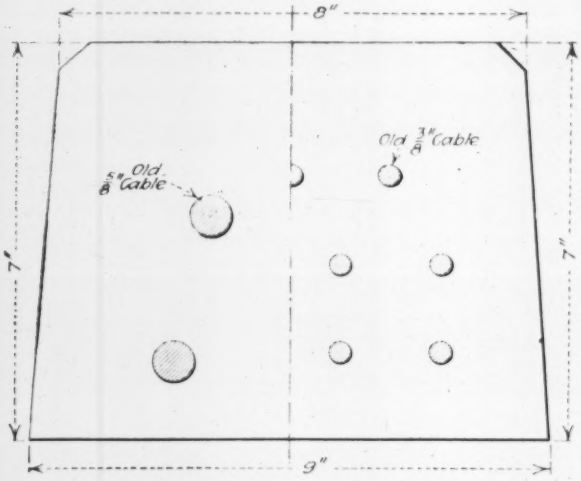


FIG. 1. REINFORCED CONCRETE TIE

that the cables have any advantage over ordinary reinforcing bars, but they are of low cost as the old cables have only a scrap value. Wood forms are used, composed of three planks held in place by clamps. The concrete mix is 1:2:4, made with crushed limestone, and the ties are cured by lying in water in shallow basins for several weeks.

The success of these ties Mr. Demaret attributes to the care that is taken in getting an even bedding on solidly packed earth. He has found by experience that a sufficiently even bedding cannot be had if ballast is used. The concrete ties are cheaper in initial cost than wood, and are used altogether for replacements, except at switches. On new lines new ties are used at first, until the roadbed gets well settled down under the action of traffic. Any unevenness of bedding, such as would occur on a new roadbed or with the use of ballast, leads to cracking the concrete ties.

Bolted clips fasten the rails, the bolts passing through holes cored in the tie, two at each rail seat. These bolts have square necks fitting square holes in a plate on the under side of the tie, the threaded ends extending through tie plates and carrying the clips and nuts. The ends of the bolts are battered with a hammer to prevent the clips and nuts from working loose, but more especially to prevent them from being stolen.

A considerable mileage of high-tension electric transmission line is maintained, all the poles being of reinforced concrete with structural steel cross arms. These poles are of rectangular section, as shown in Fig. 2, and the concrete mix is the same as that for the ties. The 40-ft. poles are 14½ and 6½ in. square at bottom and top, hollow except for about 20 per cent of the length at the top, and have a shell 2½ in. thick reinforced with twelve 1-in. round bars and with flat

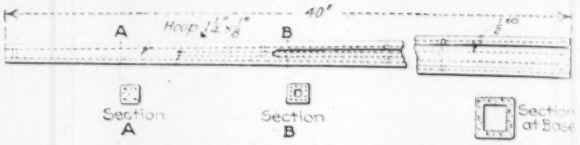


FIG. 2. REINFORCED CONCRETE POLE FOR TRANSMISSION LINES

bands 1¼ x ⅜ in. spaced about 4 ft. 7½ in. The 50-ft. poles are 17⅜ and 7¾ in. square at bottom and top and 3 in. thick, reinforced with 16 bars and hoops spaced about 5 ft. apart.

For curing the poles are covered with litter which is sprinkled periodically. Some of the reinforcing rods project from the top of the pole to serve as lightning rods and extend below the base of the poles to connect with metal plates buried in moist earth. Each pole is set in a block of inferior concrete containing something over a cubic yard.

Forms for the poles consist of planks sheathed with sheet zinc and held in place by clamps. The inside form or core is hollow, except at the ends, and the surface of the zinc which encases it is scraped and soaped each time the core is used. There is no difficulty in withdrawing this core, as it has a small screw jack at its base pushing against the concrete shell of the pole. A 40-ft. pole weighs something over a ton. The poles are erected by the use of gin-poles and ropes, the cost of erection not being a serious matter in a country where a laborer, to work at pulling on a rope or lifting, costs less than half a dollar (Chinese) a day.

That this type of electric transmission pole is a success is shown by the fact that in the many miles of line there has not been a single case of failure and no expense for maintenance, as far as poles are concerned. Although there is much wind of comparatively high velocity sleet storms (such as cause damage to transmission lines in America) are rare and storms of damp, clinging snow are practically unknown.

Cost Data

The dollar used in China was worth about nine-tenths of a U. S. dollar, May, 1920. Portland cement obtained from a mill near the mining administration's works costs $1.50 per bag, but the bag is twice as large as an American cement bag. Steel for reinforcement costs about 4c per lb. The price of wood may be estimated from the fact that an ordinary railway tie, 6 x 8 in. x 8 ft., costs $2.25. The concrete tie costs about 60c. but the rail fastenings cost over $1 per tie.

A 40-ft. concrete pole, as described above, costs about $60, not inclusive of the initial cost and wear and tear on forms. The poles are made by a Chinese contractor. He has a forge to weld the reinforcing bars and fabricate the bands, the reinforcement for each pole being built up into a unit which is kept in place in the form

by means of little blocks of concrete. The extremely reasonable cost of labor is shown in the fact that all mixing is done by hand, and that the contractor's price to the mining company for the complete fabrication of a 40-ft. pole, including keeping the poles damp until they set, is only $4.50 per pole.

Last of Federal-Aid Highway Funds Become Available

THE last of the Federal-aid funds for highway construction became available July 1, 1920. These funds, part of which are derived from the 1916 appropriation and part from that of 1919, aggregate $100,000,000. This entire amount, eliminating $3,000,000, or 3 per cent, as an administration allowance, is available to the states according to the accompanying distribution. Failure of any state to obligate its Federal-aid funds within the specified time will result in the reapportionment of funds thus not taken up. The table given herewith shows the appropriations for each state to the nearest dollar only.

State	Apportionment of Last Installment of 1916 Federal Appropriation	Apportionment of Last Installment of 1919 Federal Appropriation
Alabama	$526,221	1,578,663
Arizona	343,411	1,030,233
Arkansas	421,299	1,263,884
California	763,668	2,291,007
Colorado	438,940	1,316,819
Connecticut	153,337	460,012
Delaware	40,669	122,005
Florida	286,862	860,585
Georgia	674,288	2,022,853
Idaho	306,512	919,537
Illinois	1,091,267	3,273,801
Indiana	671,763	2,015,290
Iowa	720,332	2,160,997
Kansas	717,811	2,153,433
Kentucky	487,939	1,463,817
Louisiana	340,558	1,021,673
Maine	240,058	720,173
Maryland	216,750	650,249
Massachusetts	368,197	1,104,592
Michigan	722,917	2,168,751
Minnesota	710,522	2,131,567
Mississippi	451,889	1,355,668
Missouri	846,975	2,540,925
Montana	501,748	1,505,243
Nebraska	533,435	1,600,306
Nevada	319,086	957,258
New Hampshire	103,710	311,129
New Jersey	296,889	890,667
New Mexico	399,617	1,198,851
New York	1,242,973	3,728,920
North Carolina	569,763	1,709,290
North Dakota	384,057	1,152,171
Ohio	926,562	2,779,685
Oklahoma	575,620	1,726,859
Oregon	394,038	1,182,114
Pennsylvania	1,147,987	3,443,960
Rhode Island	58,314	174,943
South Carolina	359,005	1,077,014
South Dakota	403,945	1,211,835
Tennessee	565,478	1,696,435
Texas	1,465,400	4,396,199
Utah	282,394	847,182
Vermont	112,519	337,558
Virginia	494,418	1,483,255
Washington	361,157	1,083,471
West Virginia	265,038	795,115
Wisconsin	636,236	1,908,709
Wyoming	308,429	925,287

Public Works for Greece

A dispatch received in the State Department from Athens recently is to the effect that the Greek Minister of Communications will prepare for publication in the newspapers a brief synopsis of public works to be undertaken soon in Greece. Such works are said to include the construction of railways, draining of marshes, harbor improvements, irrigation work and hydraulic plants. It is understood that the Greek Government will welcome American competition.—*Commerce Reports.*

Piping Oil from Havre to Paris

BY the provisions of a decree published in the *Journal Officiel* of July 28, 1920, a French company, the Compagnie Francaise des Transports de Mazouts et Petroles, of Paris, has been granted permission to construct a pipe line between Havre and Paris for conveying petroleum oils from the former port to Paris and intermediate points, according to a recent issue of *Commerce Reports.* In presenting the decree to the president of the French republic for signature, the Minister of Public Works called attention to the fact that, owing to the shortage of coal, it had been found expedient to use crude oil for industrial and domestic purposes, and that, in view of the difficulties encountered in securing proper and regular transportation for oil, granting of a concession for the construction of a pipe had been considered necessary.

Some of the provisions of the concession granted include (1) the use of public roads along the line traced for construction purposes; (2) the pipe line must be capable of transporting a minimum of 2,400 metric tons of oil daily; (3) reservoirs capable of holding a minimum of 6,000 tons must be built at each end; (4) plans must be submitted to the ministry within two months of the date of granting the concession, and within a year from the date of approval of the plans the pipe line must be completed; (5) a maximum rate of 46 francs per ton is allowed for the transport of oil, and such a rate must be subject to increase or decrease by the Minister of Public Works as may be found necessary on account of the cost of labor or other items entering into the account; (6) the duration of the concession is 50 years.

It is stipulated in the concession that the headquarters of the company must for the whole duration of the concession be established in France and that the president of the administrative council together with a majority of those holding powers of attorney, the accountants and more than half of the other administrators must be of French nationality. Another condition imposed upon the company is that only French materials may be employed. Permission to purchase material abroad may be obtained from the Mnister of Public Works if it can be proved that it is impossible to procure such material in France at reasonable prices and terms of delivery.

The length of the pipe line will be approximately 125 mi.

Canadian Building Permits Show Increase

The Montreal *Financial Post* supplies figures of building permits for the current year which show considerable progress. In the seven months to July 31 permits had a value of $68,540,000 as compared with $35,656,000 in the corresponding period last year. Toronto is again in the lead with $15,570,000, a gain of 82 per cent, while Montreal permits represented $9,660,000 a gain of more than 120 per cent. Fourteen cities of the Northwest and British Columbia reported permits issued during the first seven months of 1920 having a value of $21,671,000 as against $6,766,000 for the same period last year. Winnipeg is well to the front with $6,596,000 while Edmonton makes a claim of permits of $2,983,000. By the end of the year, it is estimated, the total value of building permits in Canadian cities will approximate $100,000,000.

Quays More Economical Than Piers for Comprehensive Port

Proper Freight Handling and Storage Demands Wide Area With Many-Storied Warehouses To Utilize Land

By F. T. Chambers
Captain, Corps of Civil Engineers, U. S. N., Chief Engineer, Port Facilities Commission, U. S. Shipping Board

IN THE quicker turnaround in port is the greatest opportunity for economy of ship operation, which is the main commercial problem today before the American shipper, and secondarily the American manufacturer. It is a well-known fact that at the present time a ship of only moderate size costs its operators $5,000 per day in overhead, port and salary charges. Some months ago the Shipping Board analyzed the turnaround of a 6,450 deadweight ton vessel in the port of New York. She brought in only 2,713 tons of mixed cargo from Italy and loaded only 3,783 tons of mixed supplies for Archangel, Russia, and stayed in port 15 days. We concluded that six days would have been an entirely reasonable figure for the complete turnaround.

The analysis showed that such an improved performance would have saved in interest on investment, insurance, depreciation, supplies, wharfage, wages, stevedorage, etc., $18,596.34 and in daily profits almost an equal amount, so that by staying six instead of fifteen days in port the saving would have been in the neighborhood of $36,000. Putting it another way, in the nine days saved the vessel at its rated speed could have been 2,376 miles on its next voyage, or if it had the same saving on each trip would be in the way to make nearly eight voyages across the Atlantic instead of six per annum. Such savings are not only well worth having but may well mean success as against failure otherwise. The question arises: How can this be accomplished? The answer: By economic construction and equipment of the terminals on the one hand and their co-ordinate, economic management on the other. The first is an engineering problem, purely if not simply. To it we will address ourselves.

It may be taken as an axiom that the wharf structure must be on deep water or sufficiently close thereto so that with a reasonable amount of dredging the required depth may be had. It should also be plain that proper access is to be had to the railway systems of the port in question, for it is only by close co-ordination between ships and railways that the best results can be attained. There must, therefore, be room on the wharf for both direct transfer between ship and car and for transfer after classification between ship and car. There must also be room for city trucks as well as local industrial trucks to operate. Last, though not least, there must be room for storage of mixed cargo in classified piles, for it is not of bulk commodities that we are at present treating. Mixed cargo or package freight must be kept moving through the transit shed or congestion will result with the entailed delay and loss of economy. The transit shed problem is different from that of the storage warehouse. If the goods are to be handled at the best speed, high stacking cannot be practiced. It may sometimes be resorted to, but it is not reasonable to assume that high stacks can be erected and broken down for the same cost as those made hand high. Furthermore, aisle space for trucks of all classes must be maintained. In our calculations we have assumed aisle space of twenty per cent. It is, furthermore, necessary for the best economy that the material brought in or to be taken out by a particular ship must be stowed in the transit shed opposite that ship. Again, it is taken as a recognized fact that labor will maintain its present high wage rate and that skilled labor will be always difficult to get in quantity. From this it is assumed that more and more we must employ the

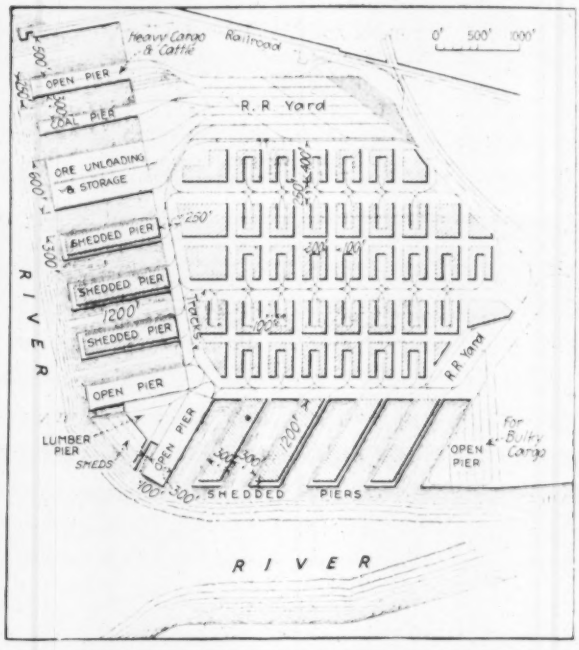


FIG. 1. PIER LAYOUT FOR A PORT AT JUNCTION OF TWO RIVERS

mechanical handlers already so successful in our factories and adapt them to the varied character of package freight.

All of these requirements make their several and individual claims upon space, some larger than others but all together totaling such an area that, if we start to design a pier with berths on each side for ships, even though we assume at once a two-story transit shed, we find our pier growing to a width of several hundred feet. Where land is valuable, as it usually is on a busy waterfront, first costs under such conditions become enormous and fixed charges for operation correspondingly great. Under such circumstances intensive use of the available area becomes imperative and loft building construction is indicated.

Short piers of moderate width can be operated with fair economy but we must, where we can, get away from the long, narrow pier construction into which some of our ports are drifting. It is not the writer's intention to take a kick at a project already so thoroughly assailed by port engineers as to make condemnation almost unanimous, but the Staten Island piers now under construction offer too good an illustration to neglect. A busy street in a metropolitan wholesale district should be as wide as the majority of these, so it stands to reason that there is insufficient room for rails, storage, etc., where so much through traffic must be provided for.

Of course there are localities where none but piers can be constructed within the means of the owner. Such

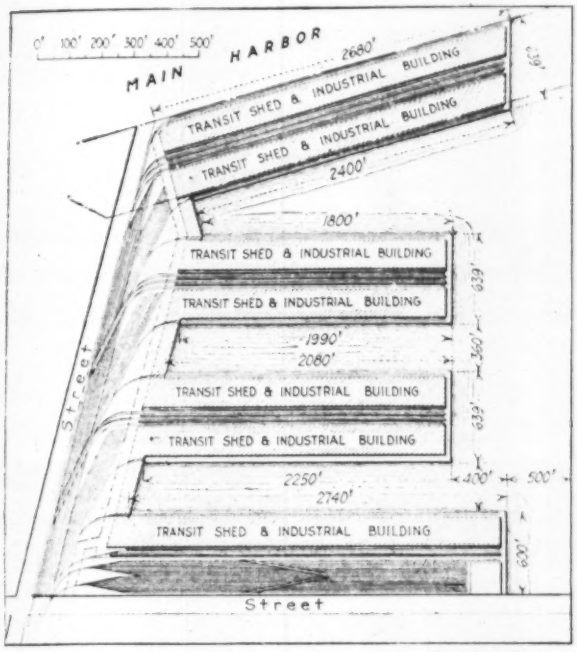


FIG. 2. QUAY LAYOUT FOR SAME AREA AS SHOWN IN FIG. 1
Prepared by Port Facilities Commission, U. S. Shipping Board

owners must effect the best economies of design within their power but cannot expect to have the most efficient. Railroads alone require running tracks as well as standing tracks on long wharf systems and in addition some nearby full and empty trackage besides the proper classification yards necessary to each group terminal. Such trackage cannot find space on the usual narrow American pier.

While lighters and barges play a prominent part in port business, there must be available means for unloading them into the transit shed. The merits of the so-called burtoning method, using a combination of the ship's winches with portable winches ashore for the transfer of cargo, are recognized and it is not necessary to enter a special plea for cranes as against portable winches, but the latter will not lend themselves readily to lighterage cargo and cranes will. The usual American transit shed, constructed close to the stringpiece of the wharf, bars forever the gantry crane as a handler on the waterfront of the pier, yet for efficiency some device must be provided for unloading purposes. The sum of the spaces required for each of the foregoing utilities, all of which are necessary to an efficient whole, results in widening the pier until it becomes something else. Open substructure construction is out of the question. Solid fill must be used and we have not a pier at all but a solid tongue of land, surrounded by a wharf or quay wall, in other words a quay system, so expensive per square foot of area that the most intensive use must be made of it to make it pay—just as New York must build skyscrapers on Broadway, so must we build loft buildings on the waterfront.

Fortunately, there is good use for these lofts. They are in the best possible location for a ware housing business and until fully required for this ultimate purpose are available for rental to jobbers, small manufacturers, etc. The first floors are for outgoing cargo, the second for incoming, and those above for pure storage. The second floor is so located that cargo coming from the ship's hold can be handled thereon without additional lift and can be discharged by gravity to trucks or railway cars below. The tongues of land are so wide that the system once adopted and the plans drawn for future expansion, all but the part required for immediate business or allowed by available funds, may be disregarded, the fill made only for the quay under development.

The most modern construction in England is on the quay principle and Dock No. 9 at Manchester is probably its best example. Here there are four-story transit sheds practically continuous along the quay, service ships on one side only, and having to each floor more area for cargo than most of the best American piers can boast as a total. They have gantry cranes, too, and ample railway trackage both on the waterfront and at the rear of the shed. The port of Hamburg, Germany, offers excellent examples of a similar nature.

The Port Facilities Commission of the Shipping Board has made studies and advised ports along these lines and as a case in point there are offered herewith two general plans laid out for the same property at the junction of two rivers on deep water. The first, shown as Fig. 1, was made some years ago by a prominent engineer on the pier principle, with an industrial development in the central area behind the piers. He was unusually liberal in his pier width but a comparison of the available industrial floor area, on the basis of six-story loft buildings, as indicated in the alternative quay plan, Fig. 2, will show the vastly greater floor area in the quay plan design. But best of all, in the quay plan we have our storage directly over our transit sheds, while his plan requires railroad cars and tracks for all transport between waterfront and storage. Not every dock lends itself to such a plan, but there are plenty that do so. The whole shallow fore-shore at Bayonne in New York Harbor should be devoted to such a plan, which would tap eight trunk

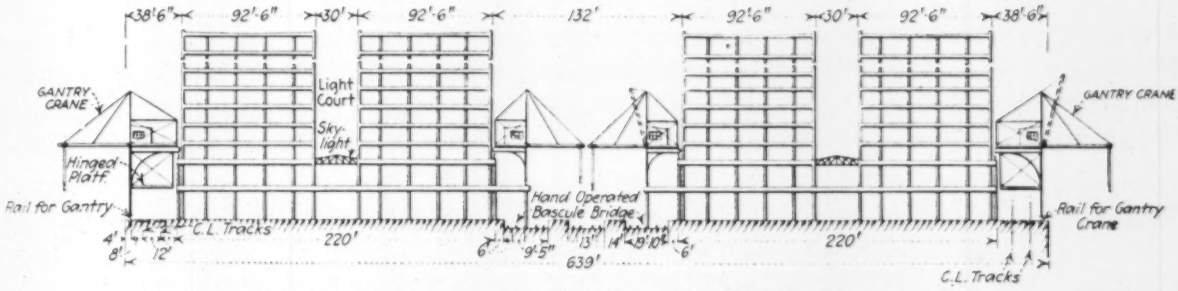


FIG. 3. TYPICAL DEVELOPMENT OF A QUAY LAYOUT FOR A PORT

line railroads at its rear. The Jamaica Bay area should have similar treatment. Baltimore and Tacoma could do the same. The cost would be large for the completed project in each case, but only part need be constructed now and the result would justify the expense.

We must do away with port authorities who are satisfied with seven and a half per cent interest on the invested capital, and look upon the port as the property of the people, for the best advancement of the city and country as a whole. The port of New York, for instance, should be viewed as a national enterprise and not as the chattel of Manhattan and Brooklyn. The result in material prosperity to the port and nation as a whole should be the ultimate goal.

The United States Government, through the Shipping Board and the Board of Engineers for Rivers and Harbors of the War Department, is now authorized by law to assist port development and an organization is being perfected to advise upon port terminal construction.

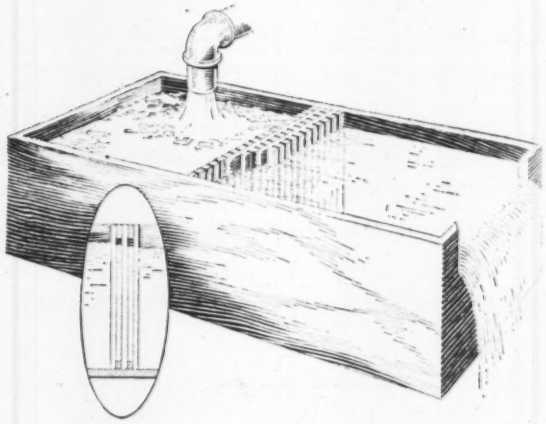
A Stilling Rack for Weirs

By George Sydney Binckley
Consulting Hydraulic Engineer, New York City

THE problem of securing a smooth and uniform flow of water toward a measuring weir is one of the minor aspects of hydrometry, yet from the writer's observation it is one in which the engineer often finds much annoyance and considerable difficulty. Almost any one who has had to do with the use of water can let his memory run back a bit, and there will come before him a series of schemes for stilling water in a weir box, all the way from a number of baffles, alternating top and bottom, to a floating mass of débris held in place somehow on the surface above the weir. Long approach channels, baffles where the water is discharged into the channel above the weir, and many other devices give more or less result, but none except the one shown in the sketch herewith has ever been found entirely satisfactory by the writer.

The device referred to, which I call a "Stilling-Rack," was the child of necessity as on one occasion I found it imperative to provide a means by which, using a very short weir box, I would be enabled to obtain a reasonably close measurement of water discharged from one centrifugal pump and one or two pulsating pumps, all operating at the same time. These conditions could hardly be worse, under the circumstances, as the turbulence produced was not alone extreme but irregular. Faced with this condition, I developed the principle of this "stilling rack," about fifteen years ago, and have used it with complete success ever since. In its original application, under the circumstances described above, the turbulence had not the slightest effect on the flow over the weir, and the pulsations were so minimized as to be easily averaged and corrections applied.

The principle upon which this "stilling rack" is based is extremely simple. The rack is composed, as seen in the sketch, of strips of wood, placed with spaces between them about one-third their width, or less, there being three sets of these strips ordinarily (although I have used more at times), separated from each other by horizontal strips, at top and bottom only, and nailed to these last, forming a unit which fills the cross-



SKETCH AND SECTION OF STILLING RACK FOR WEIRS

section of the weir box, and which is secured to it. The vertical strips in the middle series are so placed as to come opposite the openings on each side. In this way the water is deflected in its flow through the stilling rack.

In the cross-section sketch, it will be seen that the obstruction to flow caused by this rack (exaggerated in the sketch), is divided into three stages of head-loss. Hence, the momentary variations of head behind the rack, due to turbulence, cannot be transmitted to the water on the other side, as the flow is through these spaces from surface to bottom of the channel, and momentary effects of turbulence must pass in sequence and with rapidly diminishing result, these different static levels.

Employing this "stilling rack," exactly as shown, an astonishing amount of turbulence may exist behind it, and yet the flow from its face toward the weir be smooth as oil. The use of this device makes a long approach channel quite unnecessary, and indeed it may be placed in a very short weir-box, only a few feet up-stream from the weir, and results will be perfectly satisfactory.

The simple and very cheap device is so superior to any other means I have ever seen employed for this purpose that I feel justified in calling it to the attention of those who have to do with the measurement of water over weirs.

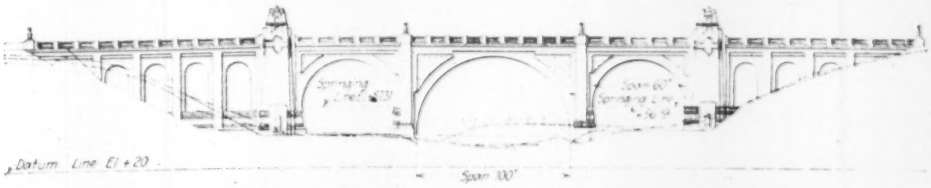
Electrification in South Africa

Electrification of two sections of line on the South African Government Railways, as the first step in a program of electrification for certain important parts of the system, has been decided upon by the Railway Administration. The general program was reviewed in *Engineering News-Record* of Jan. 29, 1920, p. 227. The two present sections are the suburban line from Cape Town to Simonstown, 22½ miles, and the main line from Durban to Pieter Maritzburg, 45 miles, the latter being the initial part of the electrification of the heavy-grade main line from Durban to Glencoe, 249 miles. Multiple unit trains are to be used on the suburban line and electric locomotives on the main line. The estimated capital investment is $2,245,830 and $2,400,000 for the two sections respectively (at present rate of exchange). Merz & McLellan, London, England, are the consulting engineers.

Bensalem Ave. Bridge—An Essay in Ornamentation

Details of Design and Construction of a Monumental Concrete Structure for Philadelphia Park System in Which Special Attention Was Paid to Appearance

CARRYING the Lincoln Highway across Pennypack creek in the northern outskirts of Philadelphia is the new Bensalem Ave. bridge. Structurally the bridge is not particularly distinctive, except for the rib details of the central arch but so much effort has been put into ornamentation and decoration that it takes the place amongst the notable of recent bridges. The crossing is in one of the newest city parks and, in addition to being on the main automobile route between Philadelphia and New York, is above a riverside road which it is expected will be quite heavily traveled. Attractiveness to those using the bridge and to those passing by or under it is therefore equally important.



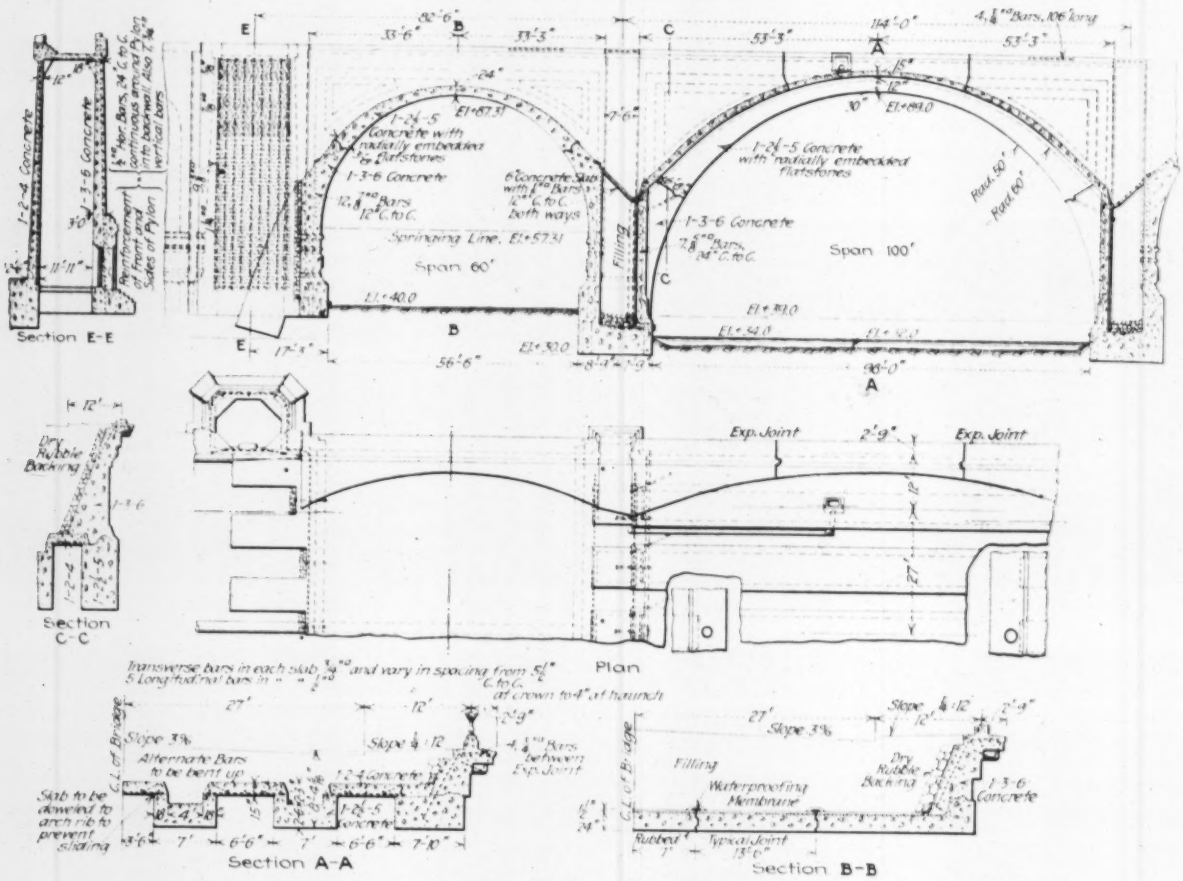
ELEVATION OF BENSALEM AVE. BRIDGE ACROSS PENNYPACK CREEK NEAR PHILADELPHIA

The bridge is 585 ft. long, made up of a central 100-ft. arch, two approach arches of 60 ft. span, and about 150 ft. of approach retained fill on each side. It is 78 ft. wide with a 54-ft. roadway and two 8-ft. sidewalks with intermediate strips of lawn 4 ft. wide. The hand rail is 69 ft. above the creek bed. Details of the construction are shown on the accompanying drawing. The two approach arches are of solid concrete of semicircular section with solid concrete spandrel walls and earth filling for the roadway. The abutments are carried down to solid rock in six buttresses, each 7 ft. wide spaced 6 ft. 6 in. apart. The approach walls are of gravity mass concrete section, with earth fill.

The central arch of 100-ft. span is made up of six arch ribs of mass concrete of 1:2½:5 mix, each 7 ft. wide and 2 ft. 6 in. at the crown, increasing to a thickness of 6 ft. 8 in. at the springing line. The earth fill of the roadway is carried on these main ribs and reinforced-concrete slabs 15 in. thick which span the main ribs resting on 12 x 18-in. projections above the main section of these ribs. These slabs, as will be noticed from the drawing, are reinforced with rods in transverse frames, bent up at about the third point to the upper part of the slab, and with continuous longitudinal rods. The outside faces of these slabs are sloped back in order to permit a free entrance of the fill to the opening in the arch ribs. The slabs are of 1:2:4 concrete and the spandrel walls, which, as will be noted from the drawing, are bonded to the outside ribs by projecting steel rods and by irregularities left in the top surface of the outer ribs, are of 1:3:6 concrete. These spandrel walls are provided with expansion joints at about the third point, as shown on the drawing. Dry rubble backing is placed against the inner slope of the spandrel wall before the fill is dumped onto the arch.

Details of line intended to add to the appearance of the bridge include the use of heavy pylons at the abutments of the two side arches, of lighter pylons at the abutments of the main central arch, or quoin line markings on the pylons and voussoir markings on the arch ribs, heavy corbels and added ornaments on the railing, and special indent markings uniformly placed in the triangular recess on the outer spandrel walls. The approach walls have recess arches on the spandrel face and are curved in plan at the approach. The main ornamental details, however, are the four large pylons between the 60-ft. arches and the wing walls. These extend from the creek level to 25 ft. above the sidewalk level on the Lincoln Highway. The top of each pylon is made into a huge lantern by means of ornamental iron work containing orange colored glass. An iron-

THE COMPLETED BENSALEM AVE. BRIDGE



DETAILS OF THE MAIN AND SECONDARY ARCH OF THE BENSALEM AVE. BRIDGE

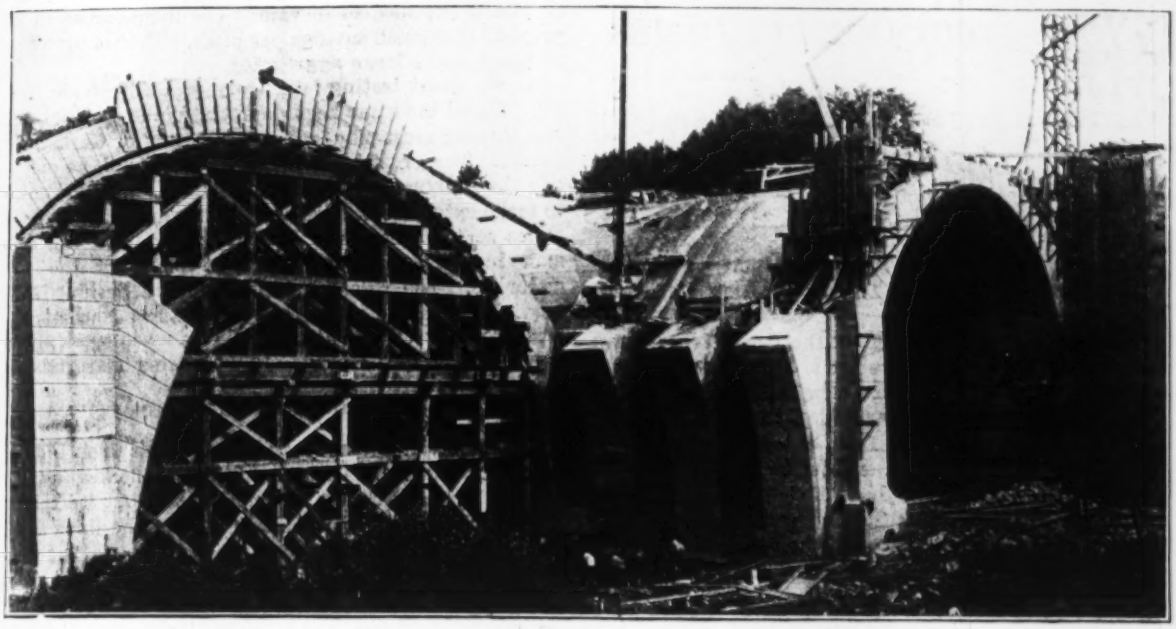
studded oak door opens into a guard house in each pylon at both street levels. The two compartments are to be connected in the future by means of a circular stairway inside the pylons. As shown on the close-up photograph the concrete detail of the four houses which hold the lanterns is very elaborate and required an extreme complication of formwork.

All exposed surfaces on the sides of the bridge were given a scrubbed finish, the outside concrete being of a different mixture than the body concrete and containing ¾-in. screened pebbles of a yellowish color. The forms had to be stripped in time to allow the concrete to be scrubbed before it became too hard. Extreme care was necessary in judging the time to strip the forms to obtain the desired finish, at the same time not weakening the construction. Scrubbing was done with ordinary steel bristle brushes and water, but generally it was first necessary to scrape the concrete in order to expose the pebbles. Form marks and imperfections were easily removed, giving a uniform appearance to the exposed concrete surface. The intrados of each arch was rubbed with carborundum brushes and a cement wash.

The most elaborate formwork was necessary to take care of the several types of concrete ornaments, all of which were built monolithic with the mass concrete excepting the pre-cast railing. The concrete in the overhanging coping, for instance, weighing 1,200 lb. per linear foot, was supported on wooden brackets bolted to the sides of the bridge by means of anchor bolts, which bolts also supported scaffolding.

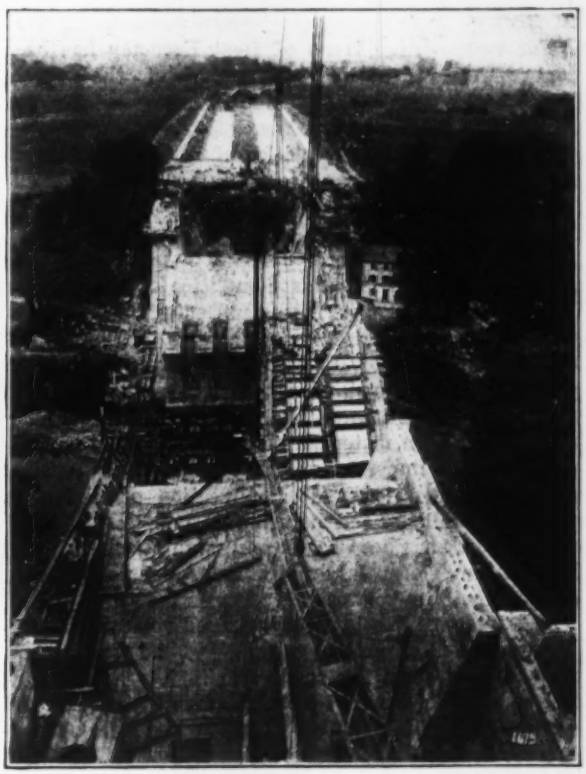
The 60-ft. arches were carried during construction on steel centers which were used three times for each arch, the shifting being done by rollers. The 100-ft. arch, on the other hand, was built on timber falsework of sufficient width to take care of three ribs, or half the arch. This centering was supported on concrete piers in the river bed and wooden cribbing, and was rolled on 6-in. hardwood rollers, the power being supplied by three 30-ton hydraulic jacks. Three men were able to move falsework, with additional men to replace rollers, etc. The lower part of the falsework, consisting of nine bents, was made into a truss by using horizontal and diagonal wooden bracing with steel cables for tension members. By this means the weight of the falsework was concentrated on three points of support, necessitating only three sets of rollers. The falsework was used twice for the arch construction after which it served as a scaffold for the use of the men who finished the intrados of the arch.

The construction plant was described in *Engineering News-Record*, April 26, 1917. As originally laid out it consisted of a central concrete mixing plant, guy derricks, and an industrial track on which were operated cars for the distribution of concrete. The two cars were connected by a cable and the grade of the track was such that the loaded car from the mixer would pull an empty car back into position for loading. The mixing plant consisted of one large mixer which was fed from overhead bins, these bins in turn being loaded by a guy derrick operating a 1-yd. clam shell. This same derrick also unloaded material from railroad



FORMWORK UNDER HALF OF CENTRAL ARCH TO BE MOVED OVER TO THREE RIBS JUST STARTED AT RIGHT OF ARCH

HIGHLY ORNAMENTAL LANTERNS AT TOP OF MAIN PYLONS OF BENSALEM AVE. BRIDGE



LOOKING ACROSS THE BENSALEM AVE. BRIDGE UNDER CONSTRUCTION

cars. After the arch work was started the concrete was handled from a 140-ft. wooden tower by spout.

The Bensalem Ave. bridge was designed in the Bureau of Surveys of the City of Philadelphia and was constructed when George E. Datesman was director of the Department of Public Works and Chester E. Albright, chief engineer, with Jonathan Jones assistant engineer in charge of bridges. The architectural details of the bridge were prepared by E. B. Baker of the Bridge Division, Bureau of Surveys. The bridge was built by Day & Zimmerman, Inc., of Philadelphia, with C. R. Camp as general superintendent of construction. The original designs were made when George S. Webster, the present chief Engineer of the Bureau of Surveys, held that position under a previous administration.

Notes from Foreign Fields

WHAT ENGINEERS ARE DOING IN GERMANY

By E. J. Mehren
Editor, *Engineering News-Record*

In A previous article the general conditions in Germany were described. The engineering conditions are not less interesting.

The war and the provisions of the Peace Treaty have created new engineering problems. There will be coal and raw-material shortage for many years, while, owing to change in source, due to areas lost to Germany, many of the materials will differ from those used before the war. The composition of the iron ore, for example, is apt to be different from that of the Lorraine mines, the chief dependence of the German steel industry before the war.

There is need, therefore, for the most efficient use of coal and raw materials. For engineering materials derived from new sources studies must be made to determine the properties and to write new specifications. These situations the German engineers have grasped, and with characteristic energy are trying to find solutions.

For example, a Bureau of Heat Economy has been formed, under the joint direction of the Verein Deutscher Ingenieure (the all-embracing engineering society of Germany), the Association of Central Electric Stations and the Association of German Iron Manufacturers, to conduct researches in fuel economy. The work is being pushed with vigor and reports are already beginning to appear.

With the same general purpose in mind there has been formed the Standards Committee of the German Industries (Normenausschuss der Deutschen Industrie) which, though organized less than two years ago, has already published 160 standard sheets and has 400 in process. Unlike the standardization work in the United States the committee is dealing with manufacturing rather than with materials standards, for in the present crisis it is important to effect as quickly as possible such standardization and simplification of design as will save both labor and materials.

The attack has been begun on design standards, also, because the Germans do not know definitely where some of their raw materials will come from.

The standard sheets already issued cover a surprisingly wide field, from tool grips, gages and wood screws to window frames for small dwellings. Standardization of parts for machine tools, automobiles, agricultural machinery and locomotives is being studied. A subcommittee has in hand the standardization of rolled shapes, while a number of subcommittees are working at high speed on the elements—doors, stairs, roofing, plumbing, etc.—of small dwellings, of which there is great shortage in Germany and on which much labor and material must be used as soon as Germany has the financial resources.

The co-operation which this committee is receiving is extraordinary, and could not, I was told, have been secured before the war. Now the necessity is such that no one is appealed to in vain. The manufacturers appreciate that small savings per piece, either in materials or labor, make large aggregates.

At the great testing laboratory at Lichterfelde, Berlin, I found the same keen appreciation of the part that engineering must play in the restoration of German industry. The great laboratories are prepared, as one by one the sources of raw materials are definitely known, to make extensive studies on the determination of properties so that there will be little delay in giving German industries full information regarding the new materials. The research men there are pushing their inquiries with the vigor that has always characterized this great testing station, and I saw much work under way on structural steels and on building materials.

Industrial Management

On industrial operation there is just as keen inquiry as on materials and design. With its colonies lost, its foreign trade gone, with ample labor but restricted materials, close study is being given to the lines along which German industry must be recast. In the past Germany exported large quantities of raw and semi-finished materials. The thinking is now directed toward a diminution of raw and semi-finished exports and an increase in finished goods. They want to market their labor rather than mere materials.

There is intimate study of methods of management and cost-keeping. Our experiments and experiences with "scientific management" are being carefully studied, and progress is being made in the adoption and utilization of such features as seem adapted to German conditions. For furtherance of management studies and exchange of experiences, there has been formed an Association of German Works' Engineers. Already there are branches in fifteen manufacturing centers, while a dozen questions, such as wage and cost systems, making and use of time and motion studies, have been formulated for study by committees and discussion at meetings. Employment methods, the influence on industry of the standardization of design, the function and place of testing in industrial works, and the lay-out and organization of factories, are other questions that are being taken in hand.

Another indication of the determination to use every resource to the utmost efficiency is the extended study being made of psychological tests for determining the individual fitness for vocations and positions.

On the matter of costs and their effect upon the industrial future of Germany there are no illusions. There are four factors that will increase the price of German goods and make it difficult for her to compete with Great Britain and America:

1. Shortage of coal and steel (imported steel will be very expensive due to the exchange, which must continue adverse to Germany for a long time).

2. High wages (which must continue until supply approximates demand).

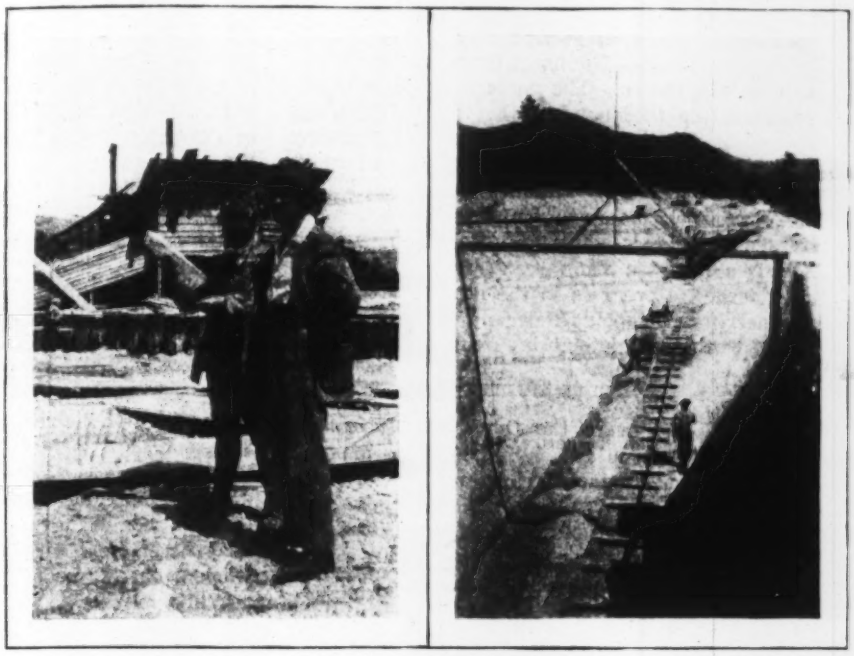
3. The heavy public debt, which necessarily throws a burden on industry.

4. The high selling costs due to the complete destruction of Germany's world-trade connections.

Realizing these conditions, the German manufacturer is giving more and more thought to the production of goods that are not only excellent but of a type not made elsewhere, realizing that if he has goods of a type and

quality not elsewhere obtainable he can get higher prices than if he competes on ordinary types and qualities. At the same time, no possible means of reducing production costs is without very thorough study. The effects of standardization, of reduction in the number of patterns produced in a given factory, of specialization by shops and individuals, are being carefully studied. In other words, not merely are direct costs—labor and materials—being subjected to critical analysis, but the overhead as well.

But even these categories do not exhaust the resourcefulness of the German industrial mind. There is extensive co-operation on commercial as well as technical lines between the big industries. Common purchase of materials, selling through trusts and cartels, and other forms of commercial co-operation are being considered with a view to reducing the costs of materials and distribution.



ON THE WALCHENSEE HYDRO-ELECTRIC WORK IN SOUTHERN BAVARIA
On the left, two of the engineers in the cofferdam of the Isar; on the right, the open canal from the Isar to the Walchensee

In the work of restoring German industry the Verein Deutscher Ingenieure is playing an important part. This organization of 25,000 members has, as already indicated, participated in the organization of the Bureau of Heat Economy; it also played a prominent part in the organization of the Standards Committee, and the offices of both bodies are in the society's headquarters in Berlin. It has also been responsible in greater or less degree for the organization of the Association for Metal Study, whose purpose is to make an extensive research into the properties and uses of metals; of a series of committees on the application of engineering to agriculture, a movement springing out of the German food shortage; of the Association of Building Construction Interests, embracing engineers, contractors, and manufacturers of building materials, resulting from a shortage in dwelling accommodation, and of the Association of German Works' Engineers, already referred to.

The publishing activities of the Verein are extensive, so extensive, in fact, that it has recently organized a publishing division, which is run, practically, as an independent publishing house. It is entirely under the control of the Verein and has its offices in the Verein's headquarters, but its business is kept separate from the administrative affairs of the society.

Since the war the publishing activities have been greatly increased. The pre-war publications included the *Zeitschrift* (the proceedings), published as a weekly engineering journal; *Technik und Wirtschaft* (Engineering and Business), a monthly; a Year Book of contributions to the history of engineering and industry, and *Forschungsarbeiten* (Research Papers), which appear irregularly. Since the war the following publications have been started: *Der Betrieb*, which discusses all phases of industrial management and is the medium for the announcements of the Standards Committee; *Technik in der Landwirtschaft*, a monthly devoted to the applications of engineering to agriculture (in this enterprise the society has the co-operation of the German Chemical Society and problems of fertilization, of crop rotation and of every phase of scientific agriculture are taken up, as well as the applications of engineering to agriculture); *Technische Zeitchriftenschau*, a monthly digest of engineering publications in all languages. In addition the Verein has undertaken the editorial direction of a propaganda organ, supported by some of the large industrial associations and published monthly in German, English and Spanish. The editorial section is strictly technical in character, the Verein having made it a condition of its participation that propaganda material of the usual type, exploiting particular machines, designs, types and processes, should not be used. In addition to these publishing activities, the society's publishing branch is handling the publications of the Bureau of Heat Economy. All of the publications carry advertising and a force of advertising salesmen is employed.

From this brief statement it is apparent that the Verein has been successful in its effort to become the co-ordinating factor in the co-operative applied-science studies and activities of Germany. Its work is carried on with singular energy and foresight, and a high devotion to the needs of the German people. We (and English engineers too) would be inclined to doubt the advisability of a technical society conducting a commercial enterprise like the publishing branch of the Verein, but from what I heard in Germany the technical activities of the organization do not seem to have suffered.

It is apparent from what is here set down that German technical development in the next 10 years will deserve the very closest study. German industrialists

and engineers in the 30 years following the Franco-Prussian war changed Germany from an agricultural to an industrial nation. The genius, the patience, the perseverance, the thoroughness that created that economic revolution are still to be found in Germany. What is more, they are now driven by dire necessity, and realize that they must bend every effort to the new and heavy task. If before the war Germany's technical progress was rapid, it will now, under the new conditions, be so accelerated that we can safely look for extraordinary technical progress in the near future. From the engineering standpoint Germany in the next decade should be the most interesting country in the world.

Deutsches Museum

For years I had heard the *Deutsches Museum*, at Munich, referred to as an engineering museum of a very unusual type. In fact, I had read descriptions of it, but they had merely strengthened my original conception that the institution was a museum, though a museum in which the exhibits were wonderfully set out.

Our American conception of an engineering museum is that of an orderly curiosity shop. Learning in them is difficult. The collections are not invitingly set forth, nor do the explanations (if any) lead one easily along the path of knowledge.

The *Deutsches Museum* is not merely a museum; *it is a people's university and laboratory*, where the explanations are inviting even to the man of average intelligence, and the principal laws of science may be demonstrated experimentally by the visitor himself.

Take, for example, the operation of a steam engine. I have seen many sectioned, movable models where the student could painstakingly learn the inter-relation of the movements of the slide valve and the piston, and follow the admission and expansion of the steam and the discharge of the exhaust, but these sectioned diagrams are a Chinese puzzle compared with the apparatus in the *Deutsches Museum*. Here the visitor can make the diagrammatic parts of a steam engine pass through their successive positions; as each important step occurs, such as the uncovering of the ports, and the movement of the piston under the expansive force of the steam, complete explanations appear at openings adjacent to the pertinent parts of the diagrammatic engine. A child of ten would have no difficulty in following and understanding what was happening.

In another room was a great variety of apparatus where the visitor, be he a boy of fifteen, a student from the *Technische Hochschule*, or a man of mature years, could perform experiments demonstrating the principles of the lever, the screw, the parallelogram of forces, etc., while adjacent were other pieces of apparatus where experiments on simple applications of these principles could be performed. The reactions of forces or loads on a beam, the lifting power of various combinations of pulleys, etc., could be studied. Similarly, there were other rooms for experiments on sound, light, heat, hydraulics, electricity, etc. In every case the development of the particular art was shown by thoroughly explained exhibits, placed alongside or near the apparatus, on which the visitor demonstrated the fundamental principles. Each piece of demonstration apparatus, moreover, was accompanied by a placard which explained with the utmost clearness the principle demonstrated.

In general, in the explanation of its exhibits, the museum is unexcelled. The placards made the asking of questions or the carrying of guidebooks unnecessary.

I wish that space permitted a description of some of the exhibits and demonstration apparatus. In the astronomical division was the best apparatus I have seen for explaining the cause of night and day and the seasons, a subject difficult to grasp without a model, unless one has an unusual imagination. The ball representing the earth, of a diameter of about 15 in., revolved on an orbit with a major axis of about 15 ft., while a strong arc light placed correctly with reference to the orbit represented the sun. With the room darkened and the earth revolving both on its own axis and along the orbit, the reason for the variation of the seasons and of the relative length of day and night was apparent.

Also in this section were a number of telescopes of different magnifications in which the planet Saturn could be seen in the magnification proper to the particular telescope and with its appropriate illumination, the whole being fully explained by accompanying placards.

While making a people's university and laboratory of the museum the historical feature has not been neglected. The development of processes and machines is well set forth.

The museum at present is housed in a building inadequate in size; in fact, it has overflowed into a second large structure. To provide it an adequate home there had been begun before the war a great reinforced-concrete structure with a plan area of 100 x 100 m., situated on an island in the Isar. The structure had been roofed in when the war came, and there it stands today in its uncompleted condition with the date for finishing probably far in the future by reason of high costs and material shortage.

The great institution owes its conception and its past and present virility to a distinguished Munich engineer, Dr. Oskar von Miller, sometime president of the Verein Deutscher Ingenieure. In building an institution of great value to the German people and German industry he has builded for himself an extraordinary and fitting monument. After it the engineering museums of the whole world may well pattern.

Hydro-Electric Power Work in Bavaria

While in Bavaria I had an opportunity of seeing under construction an interesting hydro-electric development and of learning of the plan for creating in Bavaria a great electric-power transmission network.

The Walchensee hydro-electric plant is being built under the direction of Dr. von Miller, the founder of the *Deutsches Museum*. A lake lies in the mountains so near the valley that by a tunnel and a pipe line, both short, a head of 200 m. can be developed. The watershed of the lake itself, however, will not be the sole reliance for water supply. An intake is being built on the Isar and from it 25 cu.m. per second will be taken and led to the lake. The Walchensee plant will be used to carry the peaks of both railroad and general power networks, and under maximum load will use 60 cu.m. of water per second.

Aside from the economy of the development, it has great interest because of the fact that in the one power house both Francis turbines and Pelton wheels will be

used. The four Francis units will be of 24,000 hp. each, with speeds of 500 r.p.m.; the four Pelton units will be of 12,000-hp. capacity, each with 50 per cent overload capacity, the speed being 250 r.p.m. The station will supply current both for the operation of the Bavarian railways and for general power supply. The Pelton-wheel units will supply the railway power, and were selected for this service because of the greater ease of regulation under the heavy fluctuations in current demand expected in railway work. The Francis units, on the other hand, will supply the general transmission network, where the fluctuations will not be violent. The Pelton wheels will operate single-phase generators, while the Francis units will drive 3-phase machines.

In addition to the Walchensee plant the Bavarian Government has under development four low-head plants on the Isar, near Munich, which will generate a total of 170,000 hp. They, likewise, will be connected into the Bavarian power net.

Power Network

This power net, which will be owned and operated by the government, will have 1,200 km. of main transmission line, operated at 110,000 volts. The main lines will extend from the Walchensee plant, which is in the Bavarian Alps (south of Munich), to the northern boundary of the state. A secondary network will operate at a pressure of 50,000 volts, while the local transmissions will be at 10,000 or 15,000. Into these networks all of the plants of Bavaria are to be connected, save those which, from motives of economy, will be dismantled. Where plants are not acquired by the state they will be compensated for the current they will deliver to the system. With the water power being developed at Walchensee and on the Isar and the economies resulting from the inter-connection of all large stations, it is expected that a large saving of coal will be effected, a very vital matter in view of the coal shortage with which Germany will have to contend for many years.

The design and construction of the transmission network is likewise under the direction of Dr. von Miller.

The work is an evidence of the spirit in which Germany is endeavoring to make the best of the severe conditions that have followed the close of the war.

Berlin, July 27.

Typhoid Castles in Sometown

In the first of a series of popular pamphlets entitled "Sometown," designed to promote the introduction of sewers in backward communities, the Clay Products Association, Chamber of Commerce Building, Philadelphia, discourses briefly about "typhoid castles along the back alleys." Thus:

"A good deal might be said about these typhoid castles, but you know just what sort they were. Everybody had one at the back of his lot. They made a picturesque architectural perspective along both sides of the alley as ornamental as a row of tin cans on a dump. They leaked rain and snow and bad smells, and if the holes in the ground under them filled up with water they leaked filth; but principally the leaked flies—flies that could come in and go out whenever they chose and carry their filthiness wherever a fly would naturally like to go—which seemed to be everywhere in Sometown."

Hydraulics of the Intake to a Pipe Drop

By George Henry Ellis
Great Falls, Mont.

THE Pishkun pipe drop on the Sun River Project of the U. S. Reclamation Service has an intake, the hydraulic properties of which have been determined by current-meter measurement in the canal just above the intake. Here is located one of the measuring stations

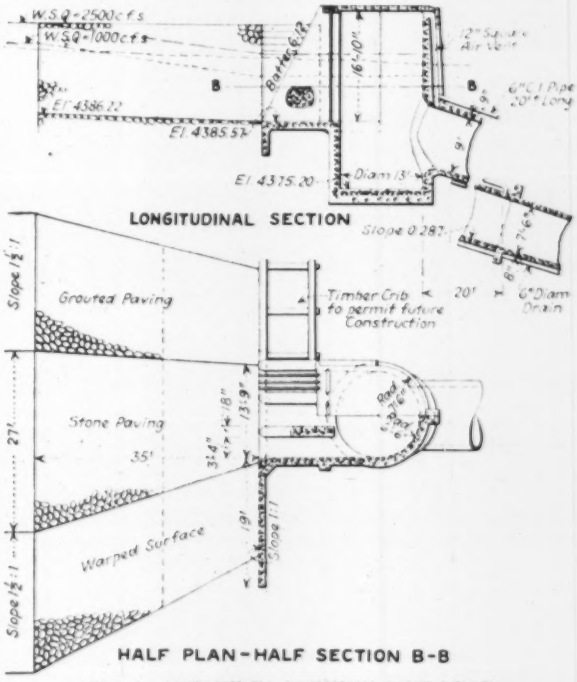


FIG. 1. INTAKE TO PISHKUN PIPE DROP

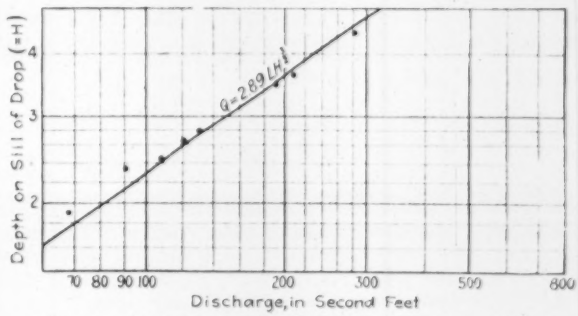


FIG. 2. DISCHARGE CURVE FROM GAGINGS 130 FT. ABOVE INTAKE

described in the *Engineering News-Record*, Jan. 8, p. 80. A drawing of the intake and a plotting of the results of nine ratings are given herewith.

It will be noticed that the paving above the intake has a fall of 0.65 ft., so that its upper end controls the water elevation at the measuring station when only a small quantity of water is running. At just what elevation this control passes from the paving to the intake is not known, but it would appear from Fig. 2 to be at a depth of about 2.4 ft. on the sill. It is probable that an exponent of 1.6 would fit the points better than that of 1.5 used, but the simple fraction is easier to use.

The 2 x 8 in. needles have not yet been installed, which leaves three clear openings of 3 ft. 4 in. each, so that L is taken as 10 ft.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Useful Data Gathered by Public Officials Should Be Published

By RUTH CANAVAN
Librarian for Metcalf & Eddy, Boston, Mass.

Throughout the past decade there has been an increasing tendency on the part of states and municipalities to curtail the printing of departmental reports, either through failure to grant appropriations or by so restricting the length of such publications as to exclude all detailed data of value. Upon the outbreak of the war this tendency gave place to a definite policy of economy, justifiable under war conditions, but deplorable as a permanent practice. It has been advocated apparently upon three grounds: High cost of printing; dearth of assistants; belief that the reports were not of general usefulness.

As exemplifying the effect which this policy has had there may be quoted a portion of two letters received in 1918. The first extract is from a state board of health in the Middle West, which has been wont to publish its reports in detail: "We are sending you a copy of the annual report of . . . . for 1915. This is the last report that will be published in separate form as the . . . . General Assembly has stopped the publication of all state reports except such as are included in the volume known as . . . . This department has done fine work in the field of sanitation and its reports have been widely read, but the volume referred to is merely a compilation of statistics." The second letter from the head of the state board of health in New England contained this statement: "I regret to state that the Printing Commission have not yet published our reports for the years 1913, 1914, 1915 and 1916. A change in personnel occurred in this office on . . . . whereby Dr. X was replaced by Dr. Y." It was subsequently determined that "the reports between the years 1912 and 1917 will never be printed."

That the municipalities have also suffered is shown by a reply received from the city engineer of a southern municipality which for six years has operated a sewage-works of exceptional interest: ". . . . the city has never seen fit to publish any data on the sewage plant; much to my regret." And an official of an eastern city with a population of over 700,000 advises: "In any case, the reports issued by this city are not in detail and I think the information given would be of little use to you."

While this policy of economy may have been justified by the exigencies of the war period it has resulted in a deplorable dearth of printed data and in corresponding duplication of work. It is a short-sighted policy not only in that it deprives the engineering profession at large, and hence those places which its members are called upon to serve, of the results of investigations and operating experience, but also because it reacts upon the morale of employees of the city or state pursuing it.

An investigation to meet some specific need is made. The problem is solved and the data which enabled its solution, instead of being worked up for publication, are filed away in the form of computations and rough draft notes. The problem in all probability becomes a matter of record, but the basic information upon which its solution depended is buried in the archives. Possibly should the same situation arise anew, those immediately concerned in meeting it in the first instance might be able to unearth the original computations or notes, but changes in personnel occur and the original notes, assuming they could be found, might prove quite unintelligible to all except the one who wrote them. This leads to a repetition of the work and hence to duplication of expense; in fact, it may mean more than duplication, since an investigation carried on in 1918 would be obviously more costly, on account of advances in salaries, railroad fares, etc., than one made ten years previously. But it is interesting to note that the same finance committee which has refused to grant the appropriation necessary for printing the information, and thus making it a matter of permanent record, will unwittingly, in its general appropriation for departmental expenses, include sufficient funds to cover the cost of this unnecessary repetition of work.

There is also to be considered the demoralizing influence upon the work of the department employee, where the results of his investigations are never to get into print. He feels that he has lost all individuality. From the accumulated evidence he deduces his findings and dutifully makes his recommendations. But his conclusions, in all probability, are not as comprehensive or as carefully formulated as they would be were the report written with the knowledge that it was to be printed. While he personally may derive benefit from the results of his investigations, the state of the art does not feel the quickening influence of the local advance, nor are others elsewhere stimulated to carry this advance further.

This willingness to share the results of his experience and to do all he individually can toward the advancement of knowledge in his particular branch of the profession, is one of the finest traits of the engineer. It is a desire which should not be thwarted—for the sake of the individual, for the sake of the profession, for the sake of the country.

How then may this desire be fostered? There have been instances of an apparent lack of sympathy on the part of the chief of the department with the desire of his subordinates to work up and publish the results of their individual efforts. In this connection it must be remembered that the creditable work of the employee reflects credit upon the department, and hence upon its chief.

If appropriations for printing matter of scientific and practical value are refused, obviously the departments cannot issue such reports. They can, however, see to it that the results of investigations are worked up in sufficient detail and so filed and indexed as to make them of permanent value; they can give publicity, through the engineering press, to the fact that investigations along certain lines are in progress or have been consummated; and, above all they can encourage, or even require, that those in their employ prepare each

year for publication in the engineering periodicals or the society journals, the more significant of their findings. By so doing, city and state departments will not only stimulate the interest and endeavor of their employees but will render valuable service to the engineering profession and the public.

Gillette a Decade Ahead of His Time

REVIEWED BY HENRY D. HAMMOND
District Engineer, The Lakewood Engineering Co., Cleveland, Ohio

EARTH WORK AND ITS COST: A Handbook of Earth Excavation—By Halbert Powers Gillette, Editor of *Engineering and Contracting*, M. Am. Soc. C. E., American Institute of Mining Engineers, etc. Third Edition. New York and London: McGraw-Hill Book Co., Inc. Flexible Cover; 5 x 7 in.; pp. 1316; illustrated. $6.

One is tempted to call this work by its proper name—a carelessly assembled collection of *almost* useless information—and let it go at that. But neither the subject, nor the book nor yet the author can be dismissed so lightly, if only for one reason. Gillette is a pioneer. He is attempting to publish something the material for which does not as yet exist—a complete treatise on the cost of many solutions to a large number of earth-handling problems. Yet, although pioneering is always tough on someone, it is most necessary, especially in the field of cost information, for the writer is not one who holds that the time will always be when accurate costs cannot be published and profitably used by others, to the great benefit of contracting. Indeed, it is a sign of the times to see works of this character appearing at all, regardless of the value of the works themselves. We have to begin somewhere.

But, in order that the pioneering effort listed above may perhaps be less dangerous to engineers and would-be contractors who may happen to read this notice, and in order to set a standard for future efforts in the same direction, it is proper, and in no way hostile or destructive, to mention some of the more glaring defects of this, the third edition of Mr. Gillette's earthwork handbook.

Although it is true, as stated by the author in the preface, that the value of cost information is not affected by age, so long as it is in terms of man-hours, and so long as the conditions are similar to work being done today, how much of the information in this work, ranging from ten to twenty years old, can pass this test? Very little, we fear. In fact, a great proportion of it can never be converted into man hours, the opportunity for that having been lost years ago when it was recorded and the job promptly forgotten. In instance after instance one or more quantities without which the equation is indeterminate are not given. Mr. Gillette set out to publish cost data, and when the best were not available, he took second-best, so to speak, to break the ice. In fact, very second-best. In one instance so much so that he omits the information altogether as being quite indeterminate, and apologizes for doing so. The only way in which such costs can be utilized by an engineer or other estimator is by taking here and there a bit of information which throws light on some unfamiliar condition, in a problem where the remaining factors are already determined. Of course, to say this much for the book is to accord it usefulness which justifies its publication. Then, too, it is almost the only available collection of data published within the last ten years.

The next most serious fault is the too great dependence upon Mr. Gillette's own paper, *Engineering and Contracting*, for quotations. A page count would perhaps reveal far more than half the book is quotations and extracts from that journal. In many instances new and blushing authors have been quoted without even removing the hair-moustache of the article—the well-known opening paragraph in which the writer tells the gaping world, "this is what you have been waiting for." Such editorial carelessness cannot be overlooked, even in Mr. Gillette.

The section of the work on steam shovels is taken almost whole from a report made years ago by Mr. Gillette's colleague, Richard T. Dana, to the Bucyrus Company, and contains at once the most practical data and some of the most doubtful-looking theory of the volume. This section will be found scant on the subject of revolving shovels as applied to modern highway work, but that was only to be expected. Such work is too new for a treatise which deals exclusively in pre-war costs, with occasional admonitions to the reader that "things have gone up one to two and a half times." The portion of the book dealing with grab buckets is deficient in information, not even distinguishing the wheel, arm and sheave types of bucket, and giving little discoverable information on the rate of handling loose material with these tools. In discussing hydraulic dredges, the largest and most efficient ever built—those used on the Toronto harbor improvement, which hold by wide margins all records for any type of excavating tool—are entirely overlooked, though other "record" data are included in the work. Other gaps might be mentioned, and will be noticed by experienced readers in each line.

In brief, then, the work needs the inclusion of real costs, which are very rare in published form, since contractors are loath to part with them; needs far better editing, with reduction of its information to man-hours instead of to dollars on an obsolete money scale, and needs to be more complete. All of which will come with time.

But it must be borne in mind that this will take time, and that the real reason why contractors do not publish their costs is a sound one. The root of this reason must be cured before real published costs are available. The trouble is that there are too many engineers and would-be contractors who are no more fitted to use the best of costs than a high-school graduate is competent to calculate the orbit of Halley's comet. This has been demonstrated so many times that it is patent to contractors. Costs, in the hands of such, are useless as Granville's *Calculus* is to a Hottentot. Worse, they are almost sure to prove destructive to some contractor. Fortunately, this class of engineer is being gradually eliminated, and the day will come when no one will be permitted to employ cost data in disposing of other people's money who cannot prove his competence to do so, just as no railroad would today commission a surveyor to design a Hell-Gate arch.

It is in anticipation of that day that the work cited is issued; and the writer of this notice, for one, hopes that, with all its necessary drawbacks, it may prove to do more good than harm, and that it may be the precursor of something more worth while to be published in the future.

Higher Mathematics for Engineers

REVIEWED BY CALEB MILLS SAVILLE

Manager and Chief Engineer, Water Department, Hartford, Conn.

MATHEMATICS FOR ENGINEERS, PART II—By W. N. Rose, B.Sc. Eng. (London). Late Lecturer in Engineering Mathematics at the University of London Goldsmiths' College, Teacher of Mathematics, Borough Polytechnic Institute. New York: E. P. Dutton & Co., Cloth; 6 x 9 in.; pp. 419; illustrated. $7.

The second volume of "Mathematics for Engineers," like the first, is intended to occupy a position midway between a theoretical treatise and a practical exposition of the uses of some of the high mathematics for the everyday problems of engineering work. The first volume (*Engineering News-Record*, May 15, 1919, p. 980), was confined to the more elementary mathematical processes of algebra and trigonometry, mensuration of solids, including conic sections, graphs and charts. The second volume, excepting a chapter on spherical trigonometry and another on mathematical probability, is devoted to the calculus, both differential and integral. The subject matter in both volumes is well presented and the practical method of handling the calculus in the second volume should be of especial value to those who, in student days, learned to apply this most useful tool by rule with little understanding of its possibilities and practical application. Prof. John Perry once said that the engineer should be taught to use calculus with the same ease that he does a chisel or a file. Few engineers do so handle it, but the expositions set forth in this book should go a long way toward an end so greatly to be desired in these days of conservation of time and energy.

The book is written from an English engineer's standpoint and many of the examples given are not of the type which would appeal most to American readers—as, for example, a problem to find the ratio of armament to displacement in a 21-knot battleship. However, the principles are plainly brought out and the only criticism is failure to hold attention by means of more familiar application. In Chap. 1 an excellent graphical exposition is given of the methods of calculus, and this should go a very long way in clearing up those doubts which persist in many minds of just how to translate problems in x, y and z into such shape as to solve practical problems, such as finding the head lost in friction when the horsepower transmitted by the main is a maximum. Such problems as this it is the purpose of the book to present in a manner that clearly shows not only their solution but also the practical application of the principles involved. The book comprises 13 chapters, all but two of which, as stated above, are devoted to the calculus in its various forms and methods. There are chapters on differentiation, including an introduction, functions, rules and applications; two chapters on integration, with a short table of integrals. Mean values, and polar co-ordinates have a chapter each. Simple differential equations and applications of the calculus receive quite complete treatment, and a short chapter is devoted to harmonic analysis. These, together with chapters on spherical triangles and mathematical probability complete the list.

Mathematical treatises, including those particularly designated for "Engineers," for the most part are of interest and value (1) to students in engineering shools, and (2) to designing engineers solving problems for construction work. The matter in the book under review, however, should be of practical use and benefit to a much larger class and is well worth inclusion among the reference books of the library of the practicing engineer to help him to solve some of his problems more easily and accurately than by approximate methods of arithmetic or the longer route of algebra.

British and American Viewpoints

REVIEWED BY R. FLEMING

American Bridge Co., New York City

STRUCTURAL STEEL WORK: Relating Principally to the Construction of Steel-Framed Buildings—By Ernest G. Beck, Wh. Ex., Assoc. M. Inst. C. E. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 462; illustrated. $7.50.

The 13 chapters of this somewhat bulky volume are entitled: Materials, Stresses and Riveted Work; Elastic Lines and Deflections; Stanchions Axially Loaded; Stanchions Braced in Groups; Stanchions Laterally and Excentrically Loaded; The Design of Stanchions; Beams and Girders; Roof Trusses; Roof Trusses with Knee-Braces; Examples of Knee-Braced Roof Trusses; Roof Trusses with Knee-Ties; Multiple-Bay Knee-Braces; Design of Roof Framing. A few tables and an index complete an octavo book of nearly 500 pp.

The author is verbose and often gives pages to a topic which an American author would cover in a few lines, if he discussed it at all. For instance, the chapter of 25 pages on roof trusses with knee-ties is given to knee-braces made of flat bars and capable of acting only as ties.

A college professor of structural engineering would be interested in the novel presentation of the Section Modulus, Moment of Inertia and Radius of Gyration. He might also wish to examine critically the chapter on columns laterally and eccentrically loaded in which the author believes he has given the first published correct investigation of the probable distribution of the wind force between the two columns of a building bent.

An American manufacturer would protest vigorously if asked to follow some of the details shown. Angles are bent romorselessly. (See Fig. 99, 100, 101, 121.) It may be said that most British textbooks show angles bent in ways that would not be tolerated in American shops. In discussing a channel column laced with 2½ x ⅜-in. flats and ¾-in. rivets (Fig. 42) the author says: "Some designers also use one rivet instead of two where the lacing bars meet on the channel flanges, lapping the bars instead of butting them. This the author strongly disapproves, on account of the extremely severe loading thrown upon the single rivet." This detail is not uncommon in Great Britain—it is shown also in Morley's classic "Theory of Structures."

Many of the methods of calculation throughout the book are not *workable* in actual practice. This, with its narrow scope, confirms the reviewer in his opinion that to an American engineer the book is of little value either for practical guidance or for reference.

In strong contrast to the reviewer's conclusion are the opinions expressed in the book reviews of British periodicals. The staid *Engineering* makes two or three trifling criticisms and ranks the book, "a very excellent piece of work." It also says: "This book will be found distinctly useful to those engaged in practical design" ". . . for sound good sense the author's treatment of his subject will be hard to beat." *The Surveyor* concludes its notice with: "It is a very practical and

useful book, and with the great expansion of industrial workshops to which we are looking forward, it should prove of great value to designers of steelwork, whether as engineers, architects or students." *The Practical Engineer* says but little, but that little is not unfavorable. *The Technical Review* is somewhat discriminating and concludes with: "We can commend this work to the man who is not satisfied to use the ordinary tables and desires to understand how the formulæ in general use have been obtained. If he is equipped with adequate mathematical training, he will then find this work a very useful guide." *Mechanical World* concludes its review with: "The book is one which we can commend with confidence as a thoroughly sound treatise on the subject."

What are the reasons for the wide difference between British and American viewpoints regarding the design of steel structures? There are excellent British books on structural design but the majority of them have little to interest the American engineer. From the American standpoint questions may be asked: Why do some British writers prefer algebraic methods where graphic methods are simpler and more quickly performed? Is entering into minutiæ to the *n*th degree thoroughness or dilettanteism? Why is there such a clinging to precedent and reluctance to change, as evident in many details of construction being repeated for a generation? Why do not British periodicals record and illustrate failures? Or, are there no failures of steel structures in Great Britain? Why are British engineers, writers and manufacturers so slow to adopt things American? Equally suggestive questions can probably be asked from the British standpoint.

A full discussion and comparison of British and American literature on structural design cannot be made within the limits of a book review. An appraisal of their relative merits by a competent engineer with an experience in both countries would be welcome.

PUBLICATIONS RECEIVED

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be obtained without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or, in case of books or papers privately printed, then to the author or other persons indicated.]

CAPILLARY MOVEMENT OF SOIL MOISTURE—By Walter W. McLaughlin, Senior Irrigation Engineer. Washington, D. C.: United States Department of Agriculture. Paper; 6 x 9 in.; pp. 70:; illustrated. 15c. from Superintendent of Documents.

CASING TROUBLES AND FISHING METHODS IN OIL WELLS—By Thomas Curtin. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 48; illustrated. 15c. from Superintendent of Documents.

CENTRAL ELECTRIC LIGHT AND POWER STATIONS: Summary of the Electrical Industries, 1917. Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 184; illustrated.

ENGINEERS UNITE: High Spots in the Washington Organizing Conference of the Federated American Engineering Societies, June 3-4 as Reported and Interpreted by the Editors of the Technical Press. New York: McGraw-Hill Co., Inc. 8 x 12 in.; pp. 64.

THE FLOW OF WATER IN DRAIN TILE—By D. L. Yarnell, Senior Drainage Engineer, and Sherman M. Woodward, Professor of Mechanics and Hydraulics, State University of Iowa. Washington, D. C.: United States Department of Agriculture. Paper; 6 x 9 in.; pp. 49; illustrated. 25c. from Superintendent of Documents.

THE FLOW OF WATER IN DREDGED DRAINAGE DITCHES: The Results of Experiments to Determine the Roughness Coefficient, n, in Kutter's Formula—By C. E. Ramser, Senior Drainage Engineer. Washington, D. C.: United States Department of Agriculture. Paper; 6 x 9 in.; pp. 60; illustrated. 30c. from Superintendent of Documents.

GEODETIC SURVEY OF CANADA: Report of the Superintendent for the Fiscal Year Ending March 31, 1919. Ottawa, Can.: Geodetic Survey of Canada. Cloth; 7 x 10 in.; pp. 77; illustrated.

GRAVITY AND PRESSURE TANKS AND SUPPORTS. CONCRETE RESERVOIRS AND VALVE PITS. Boston, Mass.: National Fire Protection Association. Paper; 3 x 5 in.; pp. 96; illustrated.

HISTORY OF THE TWENTY-SIXTH ENGINEERS (Water Supply Regiment) IN THE WORLD WAR: September, 1917 to March, 1919. For Sale by H. J. Angell, Goulds Mfg. Co., 16 Murray St., New York, N. Y. Cloth; 6 x 9 in.; pp. 258; illustrated. $2.

Reprinted from the December, 1919, Journal of the New England Water Works Association. Besides the story of the regiment as a whole there are sketches of each of the six companies, of the headquarters and medical detachments, and of various officers. Halftone plates, maps, diagrams and cartoons add to the interest of the History.

HOUSE WIRING: A Treatise Describing and Illustrating Up-to-Date Methods of Installing Electric Light and Power Wiring, etc.—By Thomas W. Poppe, Electrical Engineer. New York: The Norman W. Henley Publishing Co. Paper; 4 x 6 in.; pp. 208; illustrated. $1.

AN IMPROVED FORM OF WEIR for Gaging in Open Channels: Results of a Research Supported by Engineering Foundation—By Clemens Herschel, Past President of American Society of Civil Engineers. Reprinted from *Mechanical Engineering*, the Journal of the American Society of Mechanical Engineers, February, 1920. New York: The Engineering Foundation, Engineering Societies Building. Paper; 7 x 10 in.; pp. 26; illustrated.

INDUSTRIAL CODE: Rules as Amended Relating to the Construction, Installation, Inspection and Maintenance of Steam Boilers. New York: Bureau of Industrial Code. Paper; 6 x 9 in.; pp. 148; illustrated.

LOCOMOTIVE DESIGN IN RELATION TO GRADIENTS AND CURVES—By R. K. Biernacki, C. I. E., I. S. O., Late Locomotive Superintendent, North-Western Railway and P. G. Royal-Dawson, M. I. C. E., Chief Engineer with the Railway Board. Simla, India: The Board. Paper; 8 x 13 in.; pp. 31; illustrated. 1 rupee, 4 annas.

There is little of practical value to the American engineer on this important subject, since it deals mainly with special types of articulated locomotives on narrow gage lines (24-in. to 42-in. gage) with steep grades and sharp curves.

MICHIGAN DEPARTMENT OF HEALTH: Report of the Commissioner for the Fiscal Year Ending June 30, 1919. Lansing, Mich.: The Department. Cloth; 6 x 9 in.; pp. 196; illustrated.

NOTE ON LOCOMOTIVE DESIGN: As It Affects the Bridge Engineer—By C. W. Anderson, M. Inst. C. E. Simla, India: Railway Board of India. Paper; 8 x 13 in.; pp. 5; illustrated. 6 annas.

NOTES ON CAST-IRON SLEEPERS—By A. Lines, Deputy Chief Engineer, Eastern Bengal Railway. Simla, India: The Author. Paper; 8 x 13 in.; pp. 15; illustrated. 6 annas.

Discusses the relative merits of half a dozen forms of cast-iron ties in use in India.

PUBLICATIONS OF THE UNITED STATES RECLAMATION SERVICE: Including Publications from Other Sources Relating to the Reclamation Service. Washington, D. C.: U. S. Reclamation Service. Paper; 6 x 9 in.; pp. 95.

SEWAGE EXPERIMENTAL INVESTIGATIONS AT WEST NEW BRIGHTON, STATEN ISLAND, N. Y.: Report by Warren R. Borst. Staten Island, N. Y.: Hon. Calvin D. Van Name, President of the Borough of Richmond. Paper; 7 x 10 in.; pp. 131; illustrated.

THE SHIPPING ACT AND MERCHANT MARINE ACT, 1920: Suits in Admiralty Act, Emergency Shipping Legislation and Other Laws, Proclamations and Executive Orders Relating to the Shipping Board and Emergency Fleet Corporation. Washington, D. C.: The Corporation. Paper; 6 x 9 in.; pp. 151.

STATISTICAL ABSTRACT OF THE UNITED STATES, 1919. Washington, D. C.: Department of Commerce. Cloth; 6 x 9 in.; pp. 864. 50c. from Superintendent of Documents.

STATISTICS OF RAILWAYS IN THE UNITED STATES: Report, 1917. Washington, D. C.: Interstate Commerce Commission. Cloth; 9 x 12 in.; pp. 533.

TIMBER DEPLETION AND THE ANSWER: A Summary of the Report on Timber Depletion and Related Subjects Prepared in Response to Senate Resolution 311. Washington, D. C.: United States Department of Agriculture. Paper; 6 x 9 in.; pp. 16. 5c. from Superintendent of Documents.

TURBIDITY STANDARD OF WATER ANALYSIS—By P. V. Wells, Associate Physicist, Bureau of Standards. Washington, D. C.: Dept. of Commerce. Paper; 7 x 10 in.; pp. 28; illustrated. 10c. from Superintendent of Documents.

WATER SUPPLY AND SEWAGE DISPOSAL FOR COUNTRY HOMES—By E. J. McCaustland, Director of the Engineering Experiment Station, University of Missouri. Rolla, Mo.: The Station. Paper; 6 x 9 in.; pp. 36; illustrated.

LETTERS TO THE EDITOR

President A. P. Davis Urges Passage of Am. Soc. C. E. Amendments

Sir—The "Appeal" of Aug. 30, put out in an effort to defeat the pending amendments to the constitution of the American Society of Civil Engineers, makes a series of utterly unfounded charges:

A. Contrary to the statement of the "Appeal," the amendments criticized, with the exception of amendment F, do represent the mature views of the Committee on Development, a very representative body, and they represent the wishes of a large majority of the society as expressed in the votes on these questions in the questionnaire of last spring. They were not "railroaded" through the Portland convention, but, on the contrary, were debated at length, with no limit on the length or number of times any member should speak. The vote was not taken until debate voluntarily ceased, and the submission of the amendments was ordered by a vote of 73 to 13. All these amendments were considered and co-ordinated by a committee of the convention created for the purpose, and were passed substantially as reported by that committee, except for a few minor changes to improve the wording.

B. The "Appeal" charges that the amendments are vague and unco-ordinated and contain inconsistencies, but points out none of these alleged defects. If, after weeks of work on an effort to discredit them, the partisan author of the "Appeal" could find no basis for these charges, it is fair to assume none exists.

C. It is charged that the amendments tend toward the establishment of a political machine, which is exactly contrary to the fact. Their tendency is to increase the influence of the local sections and to decrease the power of the metropolitan machine.

D. Contrary to the statements of the "Appeal" they commit the society to no additional expense. The objections in paragraphs D and E of the "Appeal" absolutely cancel each other. Both cannot be valid.

Amendment F is designed to ameliorate the unfairness of the present representation on the Board of Direction. The number of members in District 1 entitles that district to about two and a half times the representation of each of the other districts, but instead of having two or three directors it has six, while each of the other districts has one. In addition to this, the present constitution requires one vice-president, the secretary, and the treasurer to reside in District 1, and each of these officers is ex-officio a member of the Board of Direction, thus giving that district virtually nine directors, whereas it is entitled at most to three. Amendment F corrects this by reducing the number of directors from District 1 to three, removing the requirement that a vice-president must be selected from that district and that the secretary be a member of the board. The treasurer, as now, remains a resident member of the board. This gives District 1 four members instead of nine, which is certainly liberal in view of its equitable title to less than three. The amendment contains only the necessary words to accomplish these purposes, and no inconsistencies, as any intelligent person may judge for himself by reading. A vote against amendment F is a vote to continue the unfair domination of a minority and an injustice to all the other districts.

The committee mentioned in the "Appeal" which was appointed in Portland and which the "Appeal" proposes to depend upon for "progressive" action was named entirely by one of the most extreme reactionaries and elected by the reactionaries who were in a small majority at the meeting of the directors in Portland. The progressive directors voted against it. This committee can be depended upon to bring in nothing of a progressive tendency. The defeat of these amendments means defeat of progress for an indefinite period. All real progressives should vote for all the amendments except D and E which relate to other matters. Votes already in can be withdrawn and changed.

It is hoped that no one will be intimidated by the threat to involve the society in protracted strife and litigation if these amendments be approved.

ARTHUR P. DAVIS,
President, American Society of Civil Engineers.
Riverton, Wyo., Sept. 7.

Plea for the "Annual Conference"

Sir—It is impossible to get together at either the annual meeting or the annual convention of the American Society of Civil Engineers an attendance representative of the membership as a whole. As a result the "mass-meeting government" provided by the present constitution, in the supreme authority given to the annual meeting and the annual convention, which would be ideal in a small society, is now totally inappropriate, for the "mass meeting" is never representative of any but the members in the immediate vicinity of the place where the meeting is held, or of a few devoted ones who make a commendable practice of attending all such meetings.

Whatever opinion one may hold as to the past government of the society, he must recognize the fact that that government, good, bad, or indifferent, has been a government by a small body of members, centered in and taking its inspiration from New York City. In saying this the writer attributes no ulterior motive to those who have guided the society's destinies, and believes that the result is the only one that could be expected under the present constitution. Somebody had to control the society's affairs and the men who were on the ground necessarily did it. If criticism were aroused it vented itself in a stray communication to the press, or in a swiftly smothered protest at the annual meeting, which, with one possible exception, has always been dominated by the New York membership, and has usually settled controversies by referring them to the board of direction.

Criticism at the annual conventions has fallen on deaf ears for the reason that few if any of those present were sufficiently informed upon society matters to be interested in the questions arising out of them.

This condition has discouraged many an energetic member who, realizing the impossibility of finding a place in the councils of the society without acquiescence in the dominant policies, has directed his interests elsewhere, and it has resulted that the board of direction, with its preponderant minority of New York members, has been, and under the present constitution will ever be, a non-representative body so far as the sentiment of the membership outside of New York is concerned.

The time has come when the society, if it is to be national in scope and spirit, can no longer be a local New York organization. The rumors of discontent which led first to the formation of local associations, then to the creation of the Committee on Development, and finally to the action at Portland, plainly indicate that a very considerable part of the membership outside of New York is dissatisfied with present conditions.

In order that the society may become truly national it must provide a *nationally representative body* to replace the *local mass-meetings* of the present constitution. If the membership of the society cannot attend the annual meeting and the annual convention, it can at least send accredited delegates to represent it, who by their association with the members at home can present their ideas and policies, and that is exactly what is contemplated in that portion of Amendment G applying to Article VIII of the Constitution which provides that:

"There shall be held during the Annual Convention a conference of representatives from the local sections to consider the welfare of the society and its members and to report thereon to the board of direction."

This plan, which contemplates an annual gathering of one hundred or more delegates from the several local associations, coincides with that adopted by the Federated American Engineering Societies, wherein a similar gather-

ing of society representatives constitutes the American Engineering Council, meeting annually and outlining the policies to be followed by the executive board.

Will the membership forget personal antagonisms and decide the question of the continuance of the old system or the adoption of the new after a careful study of the situation on its merits?

The society membership like the citizenship of the Nation may be divided into three classes:

1. A comparatively small group which takes an active interest in its affairs and is ever ready to assist in their direction or to oppose their misdirection.

2. A much larger group which consists of those who do not follow closely the business of the society, but rely upon the guidance of some "bell-wether," usually of the first group, to lead them when questions are submitted to a letter ballot.

3. By far the largest group, probably a majority of the membership, which is composed of those whose only interest in the society appears to be to wear its badge, to receive its publications, and to see their names in the list of members. This group appears to comprise at least 53 per cent of the membership as that number failed to reply to the last questionnaire.

Naturally the first group is divided between Progressives and Less-Progressives, and the second group follows the first in about the same relative proportions. The third group makes it possible for a few members to distribute new ballots in the last three or four days of a canvass and double the vote of any district. It constitutes in the society what corresponds to the "pocket boroughs" of British politics and the "floating vote" in our own, and is the greatest menace to the society's welfare.

Can it be persuaded to vote intelligently?

The amendment to the constitution designated "E" seems to the writer open to objection. This amendment provides, "No member of the nominating committee shall, during his term of office, be a candidate for any other office in the society."

The first objection to it is that if the amendments designated "F" and "G" are passed there will be no longer a "nominating committee" and hence the amendment is superfluous. The second objection to it is that if it be adopted and amendments "F" and "G" be rejected it will tend to prevent the most representative and best qualified members of the society from going on the "nominating committee" or else render them ineligible to membership on the Board of Direction. Therefore it is the writer's judgment that amendment "E" should be rejected.

In the interest of a more democratic or republican organization of the Society, which seems to be the expressed wish of a majority of the members, the writer endorses Amendments "A," "B," "C," "F" and "G."

Ann Arbor, Mich., Sept. 2. GARDNER S. WILLIAMS.

Computing Cross-Sections By Co-ordinates

Sir—The method of computing cross-sections as given by J. A. MacDonald in *Engineering News-Record*, July 22, 1920, p. 152, is by far the neatest and most direct method which has so far been proposed. I well remember the tedious days spent in calculating cross-section areas by the old method of trapezoids, and determined then to find some process more direct and simple with which to attain the same end. Taking up the subject of rectangular co-ordinates and applying it to railway cross-section areas, I came to the very same result that has been so clearly stated by Mr. MacDonald.

I do not know the custom on Canadian railroad surveys, but on American roads the cut or fill is usually ascertained on the center line first. This puts another term in the field notes, and indicates the center line at once, which is important, as the distances out, with one each side of the center, are added to obtain their difference or distance apart. If a sketch of each cross-section were drawn and placed before the computer it would be a guard against mistakes; but a sketch of every cross-section for 1,000 miles of road would be expensive in time and money. Without such a sketch, in going over page after page of field notes the mind grows weary and errors would most likely occur. If, however, the cut or fill for the center is interposed, the field notes will appear as follows:

— 8	— 6	— 4	— 5	— 3	— 2	— 9	— 6
22	15	12	7	0	6	12	19

The end terms for grade at edge of roadbed can be supplied mentally. The — 3 is not absolutely correct, but is taken to keep the fill in whole numbers. Although one more multiplication is necessary, yet only once do the distances out have to be added, while addition is performed twice otherwise.

The above idea is in no sense a criticism of Mr. MacDonald's method, but offered as a suggestion to guard against possible errors in computation.

It will be noticed that there are really two problems separated by the center line, but which are made one by adding together the distances out on each side of the center. As the center line is the origin of abscissae, it is more convenient to compute each way from the center.

When there is only one rod reading taken outside the edge of roadbed, it is often convenient to take one at the edge, as then the outside cut or fill multiplied by 0 cancels out; also it is sometimes convenient to know the distance above or below grade at this point. One of the situations where this method of calculating areas is most convenient is where there are both cut and fill in the same cross-section, taking care to follow the surface of the ground as it passes through the grade point.

The abscissae can be multiplied into the difference between the adjoining ordinates, but Mr. MacDonald's method is much neater and simpler, as a grade reading terminates a problem and calls attention to the fact so plainly that every chance for error is reduced to a minimum. This same method can also be used to find the contents in cubic yards directly without computing the cross-section areas at all, which is economy in both time and vexation of spirit. B. A. WAKEFIELD, C.E.

Webster, Mass., Aug. 14.

Engineers in Railroad Wage Award

Sir—I have noted the letters of W. H. Hobbs and Robert H. Baldwin published in the August 26th issue of your publication on pages 424 and 425, relative to "Engineers in Railroad Wage Award."

I have been in conference with various members of the U. S. Railroad Labor Board and I do not agree with the statement that "discrimination was used against the engineering profession."

No action has been initiated toward making an appeal to the Board in view of the adjustments for men in engineering positions that are now being made by the majority of the railroads throughout the United States, most of them after conferences with the sections of the American Association of Engineers on these roads. These increases average 20 per cent and in many cases are bringing satisfaction. Among the roads that have made this adjustment are the New York Central lines, Chicago and North Western, Illinois Central Railroad, Hocking Valley, Pennsylvania, and Southern Pacific. Other roads have indicated their intention of taking similar action, among them being the Chicago, Milwaukee and St. Paul, Santa Fe, Chicago, Rock Island and Pacific, and Pere Marquette.

The salary situation is being studied carefully, charts prepared and data compiled which will reveal to the public the surprisingly low salaries that are being paid to technical men as compared to men in other branches of railroad service, and this data is being presented to the railroad managements. Later on it is probable that some of it will be offered for publication in the columns of the technical press.

It must be remembered that by negotiations direct with the railroad managements, last year increases in salaries of railroad engineers were obtained by the American Association of Engineers amounting to over $5,000,000 annually. It is hoped, and indications now point to a satisfactory and

co-operative adjustment for present needs. The American Association of Engineers and its members desire to work loyally with the managements. Team work beats contention every time.

On the other hand patience ceases to be a virtue at a certain stage. Managements that fail to make proper adjustments in a reasonable time will have their case laid before the Wage Board.

E. L. BRANDT,
Assistant Secretary, American Association of Engineers, in charge of the Railroad Department.

Chicago, Sept. 2.

Sir—"To be or not to be, that is the question" Walter J. Sykes raises in his letter on page 279 of your issue of Aug. 5 with regard to engineering departments of railroads. The Labor Board's decision on July 20 is a report covering twenty pages. The opening sentence of the report is as follows: "This decision is upon a controversy or dispute between the organizations of employees of carriers and the carriers named below." Mr. Sykes observes that no salary or wage awards were granted to the technical employees of the engineering departments, and he desires to know why some one of the 57 varieties of engineering societies did not plead the cause of the technical men before the Board. Mr. Sykes' observation is correct, and his question a perfectly fair one.

The Board does not even mention the technical men. It grants increased pay to those employees only whose organizations were parties to the controversy. There were some 18 organizations, parties to the dispute on the employees' side, and some 313 railroad companies, parties to the dispute on the employers' side. There are over ten thousand technical railroad engineering employees, but they were not parties to the dispute, and were not considered by the Board. The Board stayed within the law that created it, and if it had decided other cases than those of parties to the dispute, it would have gone outside its jurisdiction. This is the reason also why the Board refused to grant a hearing to the Switchmen's Association on strike.

Then the law is to blame? Perhaps. But the writer ventures to assert that not 1 per cent of the ten thousand technical railroad employees took any active interest in the law while it was being passed by Congress. This assertion is not meant for censure, because if an engineer were to keep himself informed with regard to the doings of Congress he would have no time left to do engineering. He has elected representatives to make his laws for him. He certainly should pay some attention to his selection. Our representatives should be pre-eminently men and women who serve the common good. If we have a bad law, look to the men who made it. To do this, all people in all walks of life must devote sufficient of their time to these important matters which vitally affect the common good, or suffer the consequences. If 90 per cent of the people act upon the principle that self interest is best promoted by promoting the common good, and 10 per cent ignore this principle—and in their shortsightedness act contrary to it while the former are too busily engaged in their daily occupations to prevent a large majority of our so-called representatives from being chosen from the group who ignore the common good—then all together everybody must suffer the consequences. The statutory law has been made and the personnel of the Board selected by which the 18 organizations of employees obtained an average increased rate of pay of about 22 per cent while the 313 organizations of employers an increased rate of charges of about 40 per cent. The show was all staged, and those who procured tickets got seats, the others stayed out. The technical men got no tickets.

As Mr. Sykes says, "Why was this?" Why didn't the organizations do something? The principal engineering societies are organized to promote scientific and technical knowledge. As such, they have no business going into other lines of endeavor. There are a few non-technical organizations of technical men who claim to be formed to promote economic welfare. There could very properly exist an organization of technicians consisting of several distinct departments—one a technical department of applied science, one a department of pure science or theory, etc., and one a department of economic welfare. There could be sub-departments, as civil, mechanical, electrical, etc. The writer does not know of such an organization in America today, although several may be aiming that way. The Federation of Engineering Societies recently formed may develop along these lines. It is the writer's understanding that at least two of the present organizations of technical men, whose announced purpose is economic welfare, did request a hearing before the Board and were refused, because they had not complied with the law, which requires that the organized employees must have first presented their grievances to their employers and have failed to come to an understanding, before the Board is entitled to hear the case; also they must not be on strike when coming before the Board.

Some engineers like to expatiate upon the saying that "technical men are neither capital nor labor but stand between these two groups in society as professional men." It is true that they are neither capital nor labor. Nobody is either one or the other of these things. Robinson Crusoe made a boat. This simple sentence tells what capital and labor are, and neither of them was possible on that lonely island without Robinson Crusoe or some one else. The law doesn't require the Board to hear disputes between capital and labor. There are no such disputes. But it does require the Board to hear disputes between railroad employees (organized) and railroad employers (organized). Are the railroad technical men employers, employees, or professional men? An employee sells his services to an employer for salary or wages. A professional man sells his services to a client for a fee. Anyone knows that the vast majority of railroad technicians are employees. They must therefore form an employees' organization; present their requests for increased pay before their respective railroad companies, and be denied before they can under the law have their case decided by the Board. It is up to the railroad technical employees themselves. Will they meet the requirements of the law, or will they chase after some other hope?

Chicago, Sept. 3.

C. A. COTHER.

Sir—I have read Walter J. Sykes' letter published on page 279 of the *Engineering News-Record* of Aug. 5, 1920.

The technical engineers on the railroads deserved to be neglected. Any group of men who, after the experience of the last six years, do not know that force is the one thing that counts in the case of large industrial corporations dealing with their employees, and who have not the intelligence to understand that "In union there is strength," ought to be neglected; especially when these technical engineers have had the example of the locomotive engineers before their eyes for so many years.

I have another charge to make against these technical engineers on the railroads; and elsewhere. Evidently they care very little for the present comfort and the future of their wives and children, those of them who have any, for otherwise they would go out and seek a decent living for them, as have the members of the Brotherhoods, the bricklayers, carpenters, plumbers, street cleaners, and others.

How much longer are the so-called intellectuals going to be contemptible mollycoddles, supplicating individually for the right for themselves and their families to live, instead of demanding it collectively, along with, and side by side of the coal heaver, the miner, the transport worker, and other more humble members of the army of production.

CHARLES A. MULLEN,
Consulting Paving Engineer.

Montreal, Sept. 4.

[The doctrine advanced by Mr. Mullen seems to have fairly wide acceptance, but that does not make it correct. Standards are being too widely abrogated the world over. If professional men cannot keep their heads, cannot be relied on to stick to high standards, we shall sink to a very low order. "In union there is strength," is sound doctrine, but it does not necessarily mean that force must be employed. The A. A. E. has got results and it has not used threats or force, nor has it allied itself with the coal heaver, no matter how excellent an individual he may be. EDITOR.]

NEWS OF THE WEEK

New York, September 16, 1920

Constitution Adopted for Minnesota Engineering Federation

The Minnesota Joint Engineering Board and representatives from the five local engineering societies and the state chapters of all engineering and architectural organizations met at the University of Minnesota, Sept. 10, and adopted the constitution for the proposed Minnesota Federation of Engineering and Architectural Societies. The constitution follows the lines laid down in the resolution published in *Engineering News-Record* of July 1. Any society in the state, possessing local autonomy, may become a member society upon ratifying the constitution.

The board of directors of the federation will have complete power to act on all matters of public policy in the state affecting the two professions, and no society may take action contrary to that followed by the board. An annual convention is provided for the purpose of reading and discussing technical papers. The federation will publish a monthly bulletin in the interest of the federation and the member societies and will employ a paid secretary-editor. Headquarters will be in St. Paul.

The meeting was marked by a spirit of co-operation and a lack of factional strife, due, no doubt, to the encouragement given by Herbert Hoover, president of the American Institute of Mining and Metallurgical Engineers, at the recent convention of that organization in the Twin Cities. He stated that if the engineers of the state perfected their proposed federation, the force that would have the greatest influence on public welfare would be created.

Contractors Seek Views of Presidential Candidates on Construction

Each of the presidential candidates is being pressed by the Associated General Contractors of America to express himself on the construction problem which faces the nation. General R. C. Marshall, Jr., general manager of the Associated General Contractors, classes the construction problem as second only to the production and distribution of food and fuel.

Some time ago General Marshall requested of the chairmen of the two national committees that the position of the party with reference to the construction problem be set forth by the presidential candidates. Apparently this request has not been complied with and General Marshall now has taken the matter up directly with the two candidates.

To Discuss Standard Sizes and Grades of Lumber

The National Lumber Manufacturers' Association, through its Engineering Bureau, will hold a joint conference of distributors and consumers of lumber, Sept. 28 and 29 at the Congress Hotel, Chicago, to discuss suitable standard sizes and grades. C. E. Paul, construction engineer of the Engineering Bureau, has conducted a comprehensive research on the subject in co-operation with the Forest Products Laboratory, Madison, Wis., and with lumber and technical organizations with a view to devising a complete scientific schedule of standards which will best serve the needs of wood users at the least inconvenience to the manufacturer. Mr. Paul's recommendations embodied in a "Table of Association and Recommended Standard Sizes" will be discussed. Copies of the table may be procured on request to the Engineering Bureau, McCormick Bldg., Chicago.

Addition to Letter of President Davis, Am. Soc. C. E.

From Arthur P. Davis, president of the American Society of Civil Engineers, has been received, by telegraph, the following paragraph which arrived too late to be added to his letter published on p. 570 of this issue.

"There is no merit in the objection recently raised that the reduction in the number of directors is inconsistent with the requirement of Article 3 that 25 votes are necessary to elect a member of the society. Amendment F specifically provides that all officers of the society at the time of the adoption of this amendment to the constitution shall continue to serve on the Board of Direction to the end of the terms of office for which they were elected. This provides abundant opportunity for the modification of Article 3, if necessary, before the reduced number of directors can become embarrassing. The adoption of Amendment F will affect only one of the recent nominees for director from District No. 1, and the procedure in that case is governed by the provisions of Article 7 Section 7. No embarrassment is involved."

Increase in Motor License Object of New Jersey Bill

A bill is to be introduced in the New Jersey Legislature designed to increase the revenue from motor vehicle licenses from $1,900,000 to about $3,500,000 yearly, so that the state can secure additional funds for the building and repairing of roads. The Trenton Chapter of the American Association of Engineers is urging the bill's passage.

New England Water-Works Men Hold Annual Meeting

Convention at Holyoke Well Attended —Long List of Technical Papers Presented and Discussed— Committee Reports

More than two score technical papers, several committee reports, exhibits and entertainments by the Water Works Manufacturers' Association, hospitality by the Holyoke water-works and other city officials and an attendance of three hundred or more were features of the thirty-ninth annual convention of the New England Water Works Association at Holyoke, Mass., Sept. 7 to 10. Abstracts of a number of the papers appear elsewhere in this issue and others will follow.

Committee on Standard Specifications for Cast Iron Pipe—Frank McInnes, Boston, chairman, reported that following the deadlock with the pipe manufacturers in 1917 little was done by the committee. Recently he and another member of the committee visited several pipe foundries in the south and found a willingness to co-operate with the committee. Several tests bearing on mooted questions are to be made by the manufacturers. Some possible changes in making pipe were noted in the report, including the use of an electric furnace to produce iron of greater tensile strength. The committee expects to maintain close touch with pipe makers on the one hand and on the other to learn from pipe users competent to judge what their opinions are as to the proposed changes in existing specifications, particularly as to uniform outside diameter of pipe.

Committee on Revenue from Fire Service—Through W. C. Hawley, Wilkinsburg, Pa., chairman, this committee submitted a final report recommending that there should be a charge for private fire protection based on the cost of the service—in other words, a capacity charge. One of the two representatives of the fire insurance companies agreed to the general conclusions of this report but it was understood that the other would submit a minority report. In view of this probability, the convention decided to continue the committee until the minority report can be presented at one of the winter meetings.

Committee on Rainfall and Run-Off Measurements — Robert E. Horton, Voorheesville, N. Y., submitted a final report giving many data supplementary to those on yields of smaller New England streams published in the 1914 report of an earlier committee. Each

record was accompanied by a statement of governing conditions. Some evaporation records were included in the report.

Other Committee Reports—A progress report on assessments for water main extensions was submited by Caleb M. Saville, chairman. A preliminary report by the committee on uniform accounting, Albert L. Sawyer, chairman, Haverhill, Mass., included an outline of a simple system of water-works accounts, based in part on a study of state utility commission forms and suggestions by the U. S. Census Bureau. The report will come up for discussion at one of the winter meetings of the association.

The committee on the use of bonds instead of certified checks to accompany contract bids recommended the passage of a resolution by the association favoring such a substitution, the difference between the lowest bid, if withdrawn, and the contract award finally made to be collected on the bond. The discussion on the recommendation showed a division of opinion as to the wisdom of the recommendation. One member stated that deposit of a check provides cash while a bond means a lawsuit if a contract awarded is not executed by the bidder. Objection was also made to the proposal to collect the difference between the bid withdrawn and the award finally made, it being held that this might prove unfair in some cases. Action on the recommendation was postponed to one of the winter meetings.

Massachusetts Typhoid Record—Under the title (chosen by the Program Committee) "Innocence or Repentance in Drinking Waters," Henry W. Clark, chemist, Massachusetts, State Department of Health, Boston, reviewed the decline of typhoid fever in Massachusetts during the last 35 years from 45 to 2.5 deaths per 100,000 population. This record has been made with comparatively little of either filtration or chlorination. Water supplies have been improved and safeguarded and untreated sewage has been excluded from streams used for public water supplies. Without knowledge of the contents of Mr. Clark's paper, a written discussion of it was sent in by George A. Johnson, New York City. Mr. Johnson took the Massachusetts State Board of Health to task for its conservatism as to filtration and chlorination. He urged that there is and can be no insurance against pollution of water supplies and that the record thus far shown is due more to the grace of God than to the activities of the state health authorities. Mr. Clark replied, in the words of Daniel Webster, "Massachusetts stands on its record." He also said that neither he nor the State Department of Health is opposed to filtration or chlorination where they are needed.

Studies of Color in Water—Extended studies of color in a large new storage reservoir and in feeders to the reservoir, all a part of the water supply of Hartford, Conn., were presented by Caleb M. Saville, chief engineer of the Hartford water-works.

In this paper various reports by experts, made before the reservoir was built, were summarized. The studies have borne out the opinion of the late F. P. Stearns that "entering water conditions" (the term used by Mr. Saville) in a reservoir as large as Nepaug, the one in question, exert little influence on color within ordinary limits and indicate that this reservoir, like others, will show considerable color improvement as time passes and the reservoir gets "conditioned."

Unaflow Pumping Engine—Continuing his earlier papers before the New England and the American water-works asociations, D. A. Decrow, of the Worthington Pump & Machinery Corp., New York City, read a paper on "Further Tests of the Unaflow Pumping Engine," relating to a simple test unit at Buffalo, N. Y. High speeds and duties have been maintained, the latter running to and above 150,000,000 ft.-lb. per 1,000 lb. of steam, calculated from plunger displacement. A compound unit is now being built for installation elsewhere.

A New Type of Reinforced-Concrete Pipe—A proposed new type of reinforced concrete pipe was described by George C. Bartram, United Concrete Co., New York City. The pipe is modelled somewhat upon the old cement-mortar encased wrought-iron pipe used quite extensively in New England some years ago, but the steel cylinders of the new pipe are electrically welded longitudinally, then have longitudinal perforated strips welded on, inside and outside, these strips not only locking the wire or bar reinforcement to the steel cylinder, but also serving as spacers to the reinforcement. Sheet metal rings welded to the ends of the pipe lengths provide for contraction and expansion and help form bell and spigot joints. The ends of these rings are electrically welded, thus forming a continuous metal shell within the concrete. After this circumferential welding, the joints between two lengths of pipe are poured with concrete.

Trenching Machines — Satisfactory experiences with trenching machines were reported by several members, led by George W. Batchelder, water commissioner, Worcester, Mass. A. E. Martin, Springfield, reported the recent purchase of a gasoline power machine for $7,200, plus freight. Besides use for trenching, this machine has been used to remove a 16-in. pipe and to lower a 30-in. main.

In an address, Henry V. Macksey, president of the association, suggested an interchange of water-works equipment by small departments. It was voted to refer the matter to the executive committee of the assoociation, with the suggestion that it act as a clearing house of information on equipment available for rent.

Commerce Chamber Makes Appeal to Car Users

An appeal was made Sept. 9 by the Railroad Committee of the Chamber of Commerce of the United States in an open letter addressed to manufacturers and business men to join in making better use of existing railroad equipment as a means of providing immediate improvement in transportation service.

In part the statement of the committee says, "You can load and unload your cars promptly, if you will. As a rule the railroads allow you forty-eight hours free time to load your cars and forty-eight hours to unload them before any charge for demurrage. If you will use only one-half of this time, restrict your car order to today's program, avoid the duplication of car orders, and avoid the use of cars for storage purposes, you should be able to reduce the time that the average freight car spends in your hands from 37 per cent to 22 per cent of its total time, and thus add 360,000 cars to the available car supply."

Dexter Brackett Medal Awarded to Robert E. Horton

The Dexter Brackett Memorial Medal for 1919 was presented to Robert E. Horton, consulting engineer, Voorheesville, N. Y., on Sept. 8, at the annual convention of the New England Water Works Association at Holyoke, Mass., for his paper on the "Measurement of Rainfall and Snow." The medal is awarded annually to the author of the most meritorious paper, from the viewpoint of service, presented before the association during the previous year.

Road Materials Given Priority in Ohio

The Ohio State Highway Commission has secured from the Public Utilities Commission a ruling that road building materials will be given priority during the remainder of the year in order to speed up the road building program in the state. This order was secured when it was shown that road building projects in the state were being delayed by failure to receive supplies and materials. Open-top equipment under certain conditions will be furnished all contractors on state highway jobs and as a result much of the delayed highway work is going forward.

Minnesota Engineers To Back Licensing Bill

The committee of the Minnesota Joint Engineering Board on licensing of engineers and architects has prepared a bill for introduction into the Minnesota legislature this winter. The bill is similar to the model bill proposed by the committee of Engineering Council and has the backing of all engineering and architectural societies of the state.

New York Starts Pension System

Through an enabling act of the 1920 Legislature a pension system has been created, the support of which is to be shared equally between the City of New York and its employees. In the case of the administrative and technical forces it provides for optional retirement at the age of 60 and mandatory retirement at 70, with a pension allowance at the rate of one-seventieth of the average salary for the last ten years of service, for each year of service. It is thus made practicable for an employee to retire on a substantial annuity at a period in his life when he can really enjoy it.

The contributions to this fund, as explained by Arthur S. Tuttle, chairman of Engineering Council's committee on compensation of engineers, are graded according to class of service, age, and time of entrance into the city service, and range from about 4 upwards to a little over 7 per cent of the employee's salary. In case of withdrawal from the service for any cause, all contributions to this fund on the part of the employee are repaid, together with interest at the rate of 4 per cent. Incidental features of the plan include pensions for disability, life insurance to the extent of one-half a year's salary, and pensions to dependents in case of the employee being killed while in the performance of duty.

These latter benefits are paid for wholly by the city, which also assumes the burden of financing the operation of the fund for those now in the service up to Oct. 1, 1921, or such previous date as they may elect to avail themselves of it. Acceptance of the plan is optional on the part of present employees but is mandatory upon those who join the service after Oct. 1, 1920, when the system goes into effect.

Padding Road Estimates To Cover Bond Discounts Charged

Jesse E. Eschbach, chief examiner of the Indiana State Board of Accounts, issued a warning Aug. 26 to county surveyors and engineers against the padding of road estimates with an item to cover discount on bonds. Investigations recently disclosed that some engineers were including an extra item in their estimates to enable contractors to discount bonds which are not readily salable at 5 per cent, the legal rate of interest. Mr. Eschbach sent copies of the official forms for making estimates to the county officials and said that any attempt to include items not covered by the schedules will meet with prompt prosecution by the state.

S. N. Cragun, of the state board of tax commissioners, while hearing protests against road bond issues in southern Indiana recently, discovered several cases of alleged paddings of the engineers' estimates to cover bond discounts. He refused to approve the bond issues and called the matter to the attention of the State Board of Accounts.

Construction Under Way on Extensive Pit River Power Project

The Mt. Shasta Power Corporation, whose stock is owned by the Pacific Gas & Electric Co., has applied to the California Railroad Commission for a certificate declaring that public convenience and necessity require the development of the Pit River project in northern California. John A. Britton, general manager of the company, recently told the commission that his company has plans for hydroelectric power developments to cost a total of about $125,000,000, divided equally between power plants and distributing systems. The chain of developments in the Pit River region, a part of the general program, is to be carried out first. The work will involve seven plants, of which four are to be constructed now and the remainder as may be necessary.

Work started in July on two of the first four plants. These are known as Hat Creek No. 1 and No. 2 and they are to be finished by Jan. 1, 1921. These require no storage and only small diversion weirs will be used for diverting the flow. No. 1 will have 2,400 ft. of canal and 1,750 ft. of penstock developing 9,300 hp. on a 215-ft. head. No. 2, with a 4,750-ft. flume and a 400-ft. penstock, is to develop 12,300 hp. on a head of 195 ft.

The next two plants, Fall Creek No. 1 and No. 2, are just being started. They are to be completed in August, 1921. No. 1 requires 10,000 ft. of 14-ft. tunnel from which a short penstock will develop a 430-ft. head, giving 60,000 hp. No. 2 will take the tailrace water from No. 1 via a flume line to a point farther downstream when a drop of 100 ft. can be utilized to develop 18,000 hp. This makes a total of 99,000 hp. to be available by next fall from these four plants, all grouped closely together.

The three other plants, not to be constructed just yet, are all farther down on Pit River, and are to be known as Pit River Plants No. 1, No. 2 and No. 4 (No. 3 is an alternate plan not now being considered). No. 1 will have a 100-ft. dam and a tunnel line, developing 72,000 hp. on a 300-ft. head. No. 2 is to take tailrace water from No. 1 and after traversing a tunnel, develop 42,000 hp. on a 185-ft. head. No. 4 is to take the No. 2 tailrace water and after traversing a 7-mile tunnel, 20 ft. in diameter, develop a head of 932 ft. in a plant where the installed capacity is to be 232,000 hp. If present plans are carried out the latter plant would have turbines of record size. The units would be single runner vertical shaft type rated between 60,000 and 75,000 hp.

In all seven of these plants the water wheels are to be of the same type: vertical, single-runner units. The flow in the Pit basin is remarkably uniform, the seasonal variation on Hat Creek at No. 1, for example, does not exceed the range of 450 too 600 sec.-ft. At first the 60,000-volt transmission line of the California-Oregon Power Co. is to be used to deliver the power from these plants, but later on a two-circuit 220,000-volt line is to be built all the way to San Francisco.

Canadian Rate Decision Rendered

A decision authorizing an increase in freight rates in Canada of from 30 to 40 per cent was rendered at Ottawa, Sept. 9, by the Canadian Board of Railway Commisioners. Freight rates in Eastern Canada are increased 40 per cent, and in western Canada, 35 per cent, effective Sept. 13 and to continue in force until Dec. 31, after which time the increase in eastern Canada will be reduced from 40 to 35 per cent, and that in western Canada from 35 to 30 per cent. The flat percentage increase will not apply to all classes of low-grade tonnage, the increase on coal being an extra charge of from 10 to 20c. per ton.

Passenger rates were advanced 20 per cent until Dec. 31 when they will be reduced to 10 per cent for the ensuing six months, the present rates being restored July 1, 1921.

It has already been stated by Howard T. Kelly, speaking for the Railway Association of Canada, that it had been decided to grant wage increases on Canadian railroads that will meet the recent award of the Railroad Labor Board at Chicago.

Trustees of A. A. E. Investigating Purchase of Building

In accordance with action taken at the recent annual meeting of the American Association of Engineers at St. Louis, the trustees have been investigating and negotiating for the purchase of a building for the association. The City Hall Square Building of Chicago at a cost of about $1,000,000 has been considered. Purchase of a modern fireproof, twenty-story building to cost about $3,000,000 has also been investigated. Members of the association, except students, are asked to indicate an average subscription of $200 with a view to the purchase of a building of the $3,000,000 class.

Bureau of Public Roads Begins California Road Survey

In response to the request of the California Highway Commission as noted in *Engineering News-Record*, July 15, p. 140, the U. S. Bureau of Public Roads nows has a staff of about twenty men at work in California under the direction of L. I. Hewes and T. W. Allen. In addition to the careful survey of the entire highway situation that these men will make, the California tained the firm of Howe & Peters, consulting highway engineers, who will also make a report covering the situation throughout the entire state. The Automobile Club of Southern California is participating in the investigation.

Serve Notice for New Idaho-Nevada Railway Route

Notice has been served upon the governors of Nevada and Idaho that a new line of railroad, to be known as the Idaho Central, will be constructed from Wells Nev. (on the line of the Central Pacific), to Rogerson, Idaho (on the Oregon Short Line), shortening the route between Nevada and California points and between Idaho, eastern Oregon, and Washington points approximately 400 miles. The proposed route is via Contact, Nev., covering a distance of 90 miles. The Interstate Commerce Commission has communicated with the Nevada and Idaho Public Service Commissions as to the issuance of certificates of public convenience. It is understood that the serving of notices on the governors and the action of the commission is to meet the requirements of the Transportation Act. The building of the line has been proposed from time to time for the past ten or fifteen years.

San Francisco May Buy Water-Works and Street Railways

City officials of San Francisco on Aug. 24 held a conference at which it was decided to submit to ballot at the November election two charter amendments which, if adopted, will give the city the right to purchase properties of the Spring Valley Water Co. and the United Railroads. The amendment relating to the Spring Valley Water Co. provides for an increase in the bonding capacity of the city by a sufficient amount to permit the purchase of the water system in case the vote is in favor of the plan. The amendment relating to the United Railroads would change the charter so as to give the Mayor and Board of Supervisors the right to negotiate for the purchase of the system on the installment plan.

California Power Administrator Orders 15 to 20% Cut

Users of electric power in northern and central California are facing an acute shortage, according to State Power Administrator H. G. Butler, and at a conference on Aug. 19 he ordered a 15 to 20 per cent cut in the electrical energy supplied to many industries. This order affects particularly those uses in which the energy is "lost for productive purposes," such as sign and street lighting, but also it was agreed that it is now necessary that the curtailment shall fall on all important consumers and the order has been sent out to gold dredgers, cement and mining companies and electric railways.

At the conference, call to which was telegraphed to all power companies in the state, Mr. Butler stated that the relief program was planned to protect the reduced power supply caused by the series of dry years "until further relief is secured from seasonal lessening of the load or from rains." For several weeks limitations have been placed on the hours for using electricity in irrigation pumping, and this general curtailment has been in prospect for some time. From now on the companies reselling energy are to file with the power administrator all new power applications for quantities above 2½ hp., the administrator to make a ruling in each case as to whether the use is for an essential industry. The power companies themselves have been doing this for some time.

Committee on Lincoln Highway Ideal Section Named

The Lincoln Highway Association has announced the personnel of the technical committee appointed to decide what specifications will rule the construction of an ideal pavement section to be built at some point along the Lincoln Highway during 1921. The committee will receive and digest the many replies received by the association from questionnaires sent to 4,600 highway engineers in the United States requesting views as to what each engineer considered an ideal section. From these data the committee will formulate its specifications.

Members of the committee represent not only Federal, state and county highway engineers, but each technical class interested in highway construction. The personnel of the committee is given herewith:

Thomas H. MacDonald, chief, U. S. Bureau of Public Roads; A. R. Taylor, state highway commissioner, Ohio; Col. J. M. Ritchie, Motor Transport Corps, U. S. A.; F. R. White, state highway engineer, Iowa; A. R. Hirst, state highway engineer, Wisconsin; W. G. Thompson, former state highway engineer, New Jersey; Col. W. D. Uhler, state highway engineer, Pennsylvania; Edward N. Hines, chairman, Wayne County Highway Commission, Detroit, Mich.; T. R. Agg, consulting engineer, professor of highway engineering, Iowa Sate College; Clifford Older, state highway engineer, Illinois; Arthur H. Blanchard, professor of highway engineering, University of Michigan; and Col. Sidney D. Waldon, director, Lincoln Highway Association.

Program of Maintenance Meeting at St. Louis

The Roadmasters and Maintenance of Way Association of America, at its annual meeting in St. Louis, Mo., Sept. 21-23, has planned for a number of special papers including the following: "Increasing the Efficiency of Maintenance-of-Way Forces," by F. G. Jonah, chief engineer, St. Louis-San Francisco Ry.; "Maintenance of Rail Joints," J. V. Neubert, engineer of maintenance of way, New York Central R.R., and "Where Are Our Ties to Come From?" by H. Von Schrenk, consulting engineer. Committee reports will include "Weights of Rail for Various Classes of Traffic," "Equation of Track Values," "Relative Economy of Treated and Untreated Ties," "Welding Frogs and Switches," and "Construction of Highway, Street and Farm Crossings."

Pennsylvania's Highway Program Slowed Up

Recent announcements made by the Pennsylvania State Highway Department indicate that inability of contractors to obtain shipments denied them because of embargoes, and the allocation of open-top cars to transportation of coal are seriously hampering Pennsylvania's road construction program. Pennsylvania has 267 highway contracts in force at the present time, involving the construction of 993.29 mi. of highways. To date this season 109.24 mi. have been completed, a mileage which Highway Commissioner Sadler believes could be more than doubled under reasonably favorable conditions.

Zoning Regulations for District of Columbia Are in Effect

Zoning regulations for the District of Columbia, as drafted by the Zoning Commission created by Congress, became effective Aug. 30. There are four use, four height and four area districts. Notwithstanding urgent solicitation to the contrary, the commission adhered to its tentative plan of limiting the height of future buildings in the downtown section to 110 ft. The regulations have been issued in pamphlet form by the Zoning Commission.

Lumber Interests To Protest Demurrage Penalty

Preparations have been made and financed by the American Wholesale Lumber Association to seek the elimination of the $10 a day per car penalty charge on lumber and forest products held more than 48 hours. The defense is mainly that the Interstate Commerce Commission has entered a discriminatory order imposed under the guise of its being merely and solely to combat the alleged abuse of the reconsigning privilege.

November Election May Remove Bar to California Road Work

Much of the contract work on the California state highway system is still at a standstill but an endeavor is being made to hold the engineering organization together, and the prospect is that after the November election work may be resumed. The court case brought against the commission by a former secretary, W. R. Ellis, and through which work has been held up, was decided in favor of the commission in the superior court of the state and, when brought on appeal to the appellate court, an opinion was handed down sustaining the decision of the lower court. The case is now before the supreme court of the state.

Inasmuch as the California law prescribes that highway bonds be sold at par and that they yield not more than 4½ per cent interest, the State Highway Commission had set about to use

Federal funds pledged the state for highway construction to make up the difference between the statute interest limit and the market value of the bonds. The commission took the view that it could so use Federal-aid funds inasmuch as the only stipulations made by the Federal Government for the use of Federal-aid funds were state participation in the construction of the roads and Federal approval of state project plans. Inasmuch as these conditions had been fulfilled the commission contended to act within its legal right, a position which was upheld in the court's opinion. Though difficulty has been experienced in the sale of bonds there was such a ready response when signers were sought for an initiative petition authorizing a higher interest rate that it is expected the measure will pass when it goes before the voters in November. By that time it is hoped that the court case will have been disposed of.

Lighthouses To Warn Motorists of Curves and Crossings

The State Highway Commission of Wyoming has under consideration plans for the installation of "baby lighthouses" at railway crossings and on the approaches to dangerous curves on the state's entire highway system. These lights "wink" at the rate of 45 times a minute, throwing a 9-in. ray which can be seen for a distance of 3 mi. They are similar to small lighthouses along the Atlantic and Pacific coasts and the Panama canal. The light standards are 8 ft. high, mounted on cement bases, and each is a complete unit. Red lights designate railroad crossings and dangerous curves are announced by yellow lights. The frequency of accidents on mountain roads in Wyoming and Colorado, especially to tourists not familiar with mountain roads, led the commission to open negotiation with the manufacturers. A few years ago the use of large mirrors on the curves was experimented with on one or two Colorado mountain roads but with only partial success.

U. S. Engineers in M. I. T.

With the opening of the fall term, the Corps of Engineers will have forty officers pursuing courses in the Massachusetts Institute of Technology. Twenty-five of these officers have been pursuing engineering studies at the summer school with a view to shortening the time that they will have to be away from their military duties. These men are being given this work in Boston to carry out the policy of bringing military engineers in contact with civilian thought and practice.

The work being done by these officers is under the frequent scrutiny of Major V. L. Peterson, who is stationed at the district engineer offices at Boston. Major Peterson organized and conducted a course for the three-year West Point men at Camp Humphreys.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

SOUTHWEST WATER WORKS ASSOCIATION, Waco, Tex.; New Orleans, La., Sept. 20-23.

ROADMASTERS' AND MAINTENANCE OF WAY ASSOCIATION OF AMERICA, Sterling, Ill.; St. Louis, Sept. 21-23.

AMERICAN ASSOCIATION OF PORT AUTHORITIES, Montreal; Chicago, Sept. 30-Oct. 2.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, Valparaiso, Ind.; St. Louis, Oct. 10-15.

AMERICAN RAILWAY BRIDGE & BUILDING ASSOCIATION, Chicago; Atlanta, Ga., Oct. 26-28.

The American Railway Bridge and Building Association has changed the dates of its annual convention at Atlanta, Ga., from Oct. 19-21 to Oct. 26-28.

The Western Society of Engineers will open its fall series of meetings with an address by Major John C. H. Lee, Corps of Engineers, U. S. A., on "The St. Lawrence-Great Lakes Waterway Project." On Sept. 16, James A. Peabody, signal engineer, Chicago & Northwestern Ry., will speak on "The Relation of the Engineer to Railroad Transportation." L. K. Sherman, until recently president of the U. S. Housing Commssion, now consulting engineer, Chicago, will speak, Sept. 20, on "Housing Developments."

The Smoke Prevention Association will hold its fourteenth annual convention Oct. 5-8 at the Sherman Hotel, Chicago. An exhibit of equipment for burning fuel smokelessly will be shown. Frank A. Chambers, deputy smoke inspector, City of Chicago, is in charge of local arrangements.

The Louisiana Engineering Society, at its meeting held in New Orleans, Sept. 13, was addressed by Dr. I. M. Cline, district forester, Weather Bureau, New Orleans, on "Relation of Change in Storm Tides on the Coast of the Gulf of Mexico to the Center and Movement of Hurricanes."

PERSONAL NOTES

WALTER P. COPP has been appointed professor of civil engineering at Dalhousie University, Halifax, N. S.

CHARLES D. SNEAD, senior highway bridge engineer at the Fort Worth office of the U. S. Bureau of Public Roads, has been appointed successor to J. L. Parker, of the Montgomery (Ala.) district, who has recently resigned.

W. H. ANDERSON, Sulphur Springs, Tex., has been appointed drainage engineer for the St. Louis Southwestern Ry., with office at Dallas. He held a similar position with the Missouri, Kansas & Texas Railway Co., at Waco, previous to Government control of the railroads.

JOHN T. EDWARDS has been appointed supervisor of maintenance in the road department of the New Jersey State Highway Commission.

LESTER C. WALKER, for the past ten years connected with the Idaho Irrigation Co., Ltd., Richfield, Idaho, and from May, 1919, until August of this year chief engineer of the company, is now in the employ of the U. S. Reclamation Service, on surveys for the American Falls Reservoir, with headquarters at American Falls, Idaho.

MORTIMER E. COOLEY, dean of the College of Engineering and Architecture, University of Michigan, and president of the American Society of Mechanical Engineers, has been made a member of the Postal Advisory Committee, which is to study, among other things, the feasibility of handling mail in cities in underground tubes or tunnels.

H. H. TEMPLE, chief engineer of the Pittsburgh & West Virginia Ry., at Pittsburgh, has been appointed general superintendent of that road and of the West Side Belt R.R., with the same headquarters. He succeeds J. E. Fairhead, resigned.

MAJOR JOHN W. STEWART, Corps of Engineers, U. S. A., has been retired for physical disability. His last assignment was the Vicksburg Engineering District.

CAPT. PENNELL C. PAINTER, who for a number of years has been associated with the different engineering departments of the City of Baltimore, more recently as assistant engineer of the Paving Commission, has accepted the position of city engineer of Washington, N. C., where he will take charge of the extensive street paving program and the extension of the sewerage and water system, planned to start next spring.

O. W. WHITECARVER, Georgetown, S. C., has been appointed assistant engineer in the office of the U. S. district engineer at Charleston, S. C., succeeding James P. Allen, resigned. Mr. Whitecarver has been assistant engineer at Georgetown for the last 20 years.

J. L. PARKER recently resigned as senior highway bridge engineer of the Montgomery, (Ala.) district, U. S. Bureau of Public Roads, to become special bridge engineer of the South Carolina State Highway Commission.

The Seaboard Air Line Ry. announces the following promotions and transfers: W. A. GREENLEAF, division engineer, at Savannah, Ga., transferred to the North Carolina division, at Hamlet, N. C. C. M. CANNON, division engineer of the East Carolina division, at Charleston, S. C., appointed division engineer of the Alabama division,

at Savannah, succeeding W. A. Greenleaf, promoted. W. J. GOODING, division engineer of the South Carolina division, at Jacksonville, appointed division engineer of the East Carolina division, at Charleston, succeeding C. M. Cannon, transferred. O. F. McNAIRY appointed division engineer of the South Carolina division, at Jacksonville, succeeding W. J. Gooding, transferred.

JAMES P. ALLEN, who recently resigned as assistant engineer in the U. S. district engineer office at Charleston, S. C., will engage in a private engineering business. Associated with Mr. Allen will be W. S. Fitzsimons, recently second assistant engineer in the Charleston office.

G. C. PYLE has been appointed chief engineer of the Arkansas & Louisiana Missouri (formerly the Arkansas & Louisiana Midland) Ry., with headquarters at Huttig, Ark.

I. H. SCHRAM, recently division engineer on the Erie R.R., has been promoted to the position of terminal superintendent, with offices at Marion, Ohio.

J. Y. MCCLINTOCK, for more than 17 years in charge of highway work in Monroe County, N. Y., has become associated with George R. Newell, civil engineer, with offices in Rochester, N. Y. They are prepared to consider problems in engineering, including studies, surveys and reports, preparation of contracts and construction work.

Dr. ARTHUR M. BUSWELL, associate professor of engineering, Columbia University, has become director of the Illinois State Water Survey.

COLONEL J. P. JERVEY, Corps of Engineers, U. S. A., in charge of the Baltimore district, has submitted his application for retirement. He requests that his retirement become effective on Sept. 21, as he desires to assume the duties of city manager of Portsmouth, Va., the following day.

H. B. HOLMES has been appointed chief engineer of the Pittsburgh & West Virginia Ry. and the West Side Belt R.R., with headquarters at Pittsburgh, succeeding H. H. Temple, promoted.

ROBERT M. GATES, engineer in the New York office of the Lakewood Engineering Co., Cleveland, has been appointed managing engineer in charge of the Philadelphia district of the company, with headquarters in Philadelphia.

J. C. DAVIS, formerly connected with the University of Oklahoma, has been made testing engineer for the State Highway Department, with headquarters at Oklahoma City.

A. W. HARDY has been appointed resident engineer on the bridge now being built between Minco and Union City, Okla.

BUSINESS NOTES

AGNEW T. DICE, JR., railroad sales manager of the Reading Iron Co., Reading, Pa., in addition to discharging the duties of that position, has been placed in charge of the company's cut nail output.

THE JEFFREY MANUFACTURING CO., Columbus, Ohio, has opened a branch office in the Marine Trust Building, Buffalo, in charge of H. W. Scott, formerly of the home office of the company. Mr. Scott will be glad to render assistance to clients in that territory in the handling of problems covering elevating, conveying, crushing, pulverizing and portable loading machinery.

THE MESTA MACHINE CO., Pittsburgh, has opened an office in the Singer Building, New York, from which point all of its foreign business will be handled. The New York office will also be the sales office for the New York and Eastern states territory. M. M. Moore, export sales manager of the company, who has just returned from Europe, will be in charge of the new office.

OBITUARY

THOMAS M. SCHENK, district engineer, at Halifax, for the Public Works Department of Canada, died Sept. 4 at Montreal. He was 32 years of age.

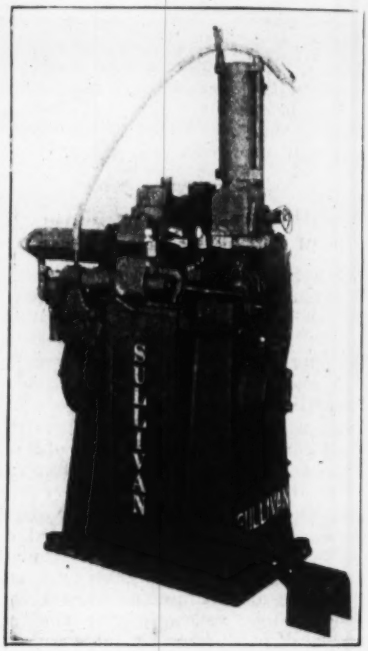
Sullivan Light Model Drill Sharpening Machine

The machine shown in the accompanying illustration is known as the Sullivan Class B Sharpener, and is designed for handling solid or hollow drill steel of any section up to 1¼ in. in diameter, and to make bits up to a maximum gage of 2½ in. The Class B Sharpener weighs 1,500 lb.; is very compact, occupying a floor area of 4 ft. x 2¼ ft.; and stands 5 ft. high.

The essential features of the Class B Sharpener consist of a horizontal hammer cylinder and piston operating a dolly for upsetting, and a vertical cylinder and piston operating dies for swedging the drill bits or shanks. For upsetting bits or shanks the steel is clamped in steel dies mounted in the lower, or stationary, and upper, or movable, jaws of a yoke operated by a horizontal air cylinder situated in the base of the machine.

The clamping cylinder and piston are of the differential type, the clamping end being 10 in. in diameter and the releasing end 4 in. in diameter. The horizontal movement of the piston is communicated to the vertical action of the vise by the air power acting through a double toggle. The combined effort of the air power and toggle leverage is estimated as being more than 50,000 lb., all of which is applied to hold the steel firm in the vise.

In making or resharpening bits the steel is shifted from one hammer to the other, being alternately upset and swedged until of the proper gage and shape, and the wings, corners, and cutting edge properly drawn out to be uniform, and of the right thickness and angle. With a little practice perfect bits of the usual shape are made in one heat in a minute or less, on either solid or hollow steel. Ordinary dull bits may be sharpened in from twenty to twenty-five seconds. In making shanks one heat is sufficient to forge those that require upsetting only, or swedging only, and two heats are necessary for shanks requiring both upsetting and swedging.



LIGHT MODEL DRILL SHARPENER

Civil Service Examinations United States

For the United States civil service examinations listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Junior Engineer and Deck Officer, $2,000 to $2,240 a year. Examinations Oct. 6-7, Dec. 8-9. Apply for Form 1312.

Rural Engineering Draftsman, $1,800 to $2,200 a year. Apply for Form 1312. Applications must be filed not later than Oct. 12.

Assistant Testing Engineer, $2,100 to $2,700 a year. Apply for Form 2118. Applications must be filed not later than Oct. 19.